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Effects of rate of imagery in mental practice on the performance of a complex motor skill

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THE EFFECTS OF RATE OF IMAGERY IN MENTAL PRACTICE ON THE PERFORMANCE OF A COMPLEX MOTOR SKILL

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The purpose of this study was to examine the effects of Mental Practice (MP), Slow Motion Mental Practice (SMMP), and an Attention Placebo Control (APC) on the performance of the putting throw involved in the game of Frisbee disc golf. Sixty-six male Introductory Psychology students were randomly assigned to the three groups and participated in a pre-treatment performance session, a five session treatment phase, and a post-treatment performance session. Pre- to post-treatment performance changes were examined, as were repeated measures manipulation check questionnaires. It was hypothesized that the SMMP group would improve the most of the three groups due to the possible imagery-enhancement effects of the slowed presentation of mental practice. It was further hypothesized that the MP group would also show significant improvement. Finally, it was hypothesized that the APC group would show slight non-significant improvement because of the expectancy for improvement provided in their instructional program. Performance analysis of variance (ANOVA) revealed no significant main or interaction effects, but did indicate a slight trend toward improvement on the repeated measures factor. Questionnaire ANOVAs suggested that the treatments were, in general, administered as planned, and that there were no significant between-groups differences on the factors examined. Furthermore, it was found that the slow motion factor was not effectively manipulated, therefore the slow motion hypothesis presented in this study remains to be tested. Finally, a number of suggestions for the improvement of the present design were offered, and it was concluded that further, methodologically-sound and theoretically-based experimentation is needed in this area.

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INTRODUCTION

Mental practice has been defined as "the symbolic rehearsal of a physical activity in the absence of any gross muscular movements" (Richardson, 1967a, p. 95). It has further been described as the "repetition of a task, without observable movement, with the specific intent of learning" (Corbin, 1972, p. 94). This process of practicing a skill in one's mind has also been called by many names. In the nearly seventy years since mental practice first appeared in the literature (Washburn, 1916), the procedure has been referred to as mental rehearsal, imaginary rehearsal, symbolic rehearsal, covert rehearsal, implicit practice, and conceptualizing practice. Regardless of the definition or terminology, mental practice has been widely researched, and has been applied in a vast number of situations.

Although many mental practice studies have been conducted in the areas of symbolic or ideational learning, the majority of the research is concerned with the effects of mental practice on the performance of motor skills. Furthermore, a substantial amount of this research is found in the sport psychology literature, a discipline which is currently enjoying widespread application in both amateur and professional athletic settings. Mental practice and its derivatives have been employed by ski racers (Suinn, 1972), bowlers (Barnes, 1982), dart throwers (Epstein, 1980;

Vandell, Davis, & Clugston, 1943), gymnasts (Gilmore, 1973; Meyers, Schleser, Cooke, & Culliver, 1979), basketball players (Meyers & Schleser, 1980; Meyers, Schleser, & Okwumabua, 1982; Vandell et al., 1943), tennis players (Noel, 1980; Surburg, 1968; Weinberg, Gould, Jackson, & Barnes, 1980), volleyball players (Shick, 1970), karate students (Weinberg, Seabourne, & Jackson, 1981), swimmers (White, Ashton, & Lewis, 1979), and golfers (Glore, 1982). This list is by no means exhaustive, but it helps to illustrate the fact that mental practice techniques have been applied in a broad fashion over a number of years. It is the task of both the literature reviewer, and the conscientious researcher to make sense of the available literature in order to determine whether this widely utilized technique indeed has merit as a performance enhancement technique, or whether it has been blindly misapplied.

Literature Review

It is not the task of the present study to review and critique the entire mental practice literature, since this has been attempted on a number of previous occasions (Corbin, 1972; Richardson, 1967a, 1967b; Weinberg, 1982). The goal of the present review of the mental practice research, rather, is to 1) summarize that which has already

been stated by these reviewers with the inclusion of several studies which have not yet been reviewed, 2) to illustrate some of the methodological inadequacies in the area, and 3) to summarize the general conclusions which have been drawn as a result of this considerably large body of research.

Perhaps the earliest writings on mental practice were done by Washburn in 1916. Washburn reiterated and expanded on William James' (1890) ideomotor theory when she postulated that one's imagination of an activity leads to slight muscular movements, and furthermore, that this movement is the same as actual overt movement of the muscles, but on a much smaller magnitude. Washburn did no more than speculate about this process, and it was not until 1932 that the notion was studied empirically.

Jacobson (1932) performed a thorough study of the muscular responses which occur as a result of imagining when he recorded electromyographic (EMG) responses during the imagining of physical activity. It was also found that the EMG activity was greatest for those individuals who had previous movement experience. Jacobson's work supported Washburn's (1916) position, but it did not address the issue of whether mental practice leads to improvement in motor performance.

Sackett (1934, 1935) was one of the first researchers to study the relative effects of mental practice of a skill, as compared with actual physical practice of the skill. The performance tasks Sackett used, as were the overwhelming majority of the tasks used in all mental practice research at this time, were primarily "ideational or symbolic" in nature. Sackett's tasks included card sorting, mirror drawing, and maze tracing. Sackett's results suggested that physical practice led to greater performance enhancement than did either mental practice or a no practice control group. Mental practice was, however, somewhat beneficial to performance and retention of the skills. These results, like a great number of results from subsequent studies, can be questioned on methodological grounds, however. Sackett had each subject in both mental and physical practice groups practice the skills as often as possible each day. For the data to be validly interpretable, the subjects in each group must perform the same number of practice trials. In other words, the number of practice trials must be equal for both mental and physical practice subjects. Only in this way can the two practice modes be adequately compared.

In 1936 Eggleston (cited in Weinberg, 1982) utilized card sorting, a sensory motor task, and digit substitution, an ideational task, in the study of the relative effects of mental practice, physical practice, and no practice.

Results indicated that although both mental and physical practice resulted in substantial performance gains on both tasks, only the physical practice group performed significantly better than the no practice group. From these results, Eggleston concluded that physical practice is marginally superior to mental practice on these specific tasks, but that mental practice is still an effective learning technique.

Another early study explored the effects of mental practice, physical practice, and no practice on tapping, card sorting, digit substitution, mirror drawing, and a peg board task. Perry (1939) tested elementary school children on these cognitive learning tasks and found that, on selected tasks, mental practice was as effective as physical practice.

In 1956, Morrisett (cited in Richardson, 1967b) stated that all tasks require certain proportions of three basic skill dimensions, and that each task is predominantly either symbolic, perceptual, or motor in composition. According to Morrisett, mental practice would be most effective on those tasks which were predominantly symbolic and/or perceptual, and that motor tasks would be likely to show no effects from mental practice. To test this hypothesis, Morrisett had judges select a number of tasks which were high in one component, but low in the other two. Morrisett concluded

that mental practice facilitated performance in symbolic and perceptual skills, but that it had little effect on motor skills. As Richardson (1967b) pointed out, however, Morrisett's conclusions with respect to motor tasks may be a bit insecure. Apparently, on one motor task (dart throwing), Morrisett required the subjects to engage in mental practice for a full 21 minutes. As previous research had suggested (see below, Twining, 1949), the optimum trial time for mental practice appears to be no more than five minutes. This may have led to lowered motivation in the mental practice subjects, and lowered resulting performance scores.

Perhaps the most widely cited study on mental practice was performed by Vandell, Davis, and Clugston in 1943. This was probably the first mental practice research which utilized motor tasks as opposed to primarily cognitive tasks. Vandell et al. selected male junior high school, senior high school, and college freshman students to engage in either no practice, 20 days of physical practice, or 20 days of mental practice of either free throw shooting (senior high students) or dart throwing (junior high and college students). Pre-treatment performances were compared with post-treatment performances, and it was concluded that both physical and mental practice were equally effective in the development of these particular motor skills. This

study has been criticized on numerous occasions, however, since it lacks statistical analyses and since it used a very small n (four per treatment cell). In addition, it does not appear as though Vandell et al. placed any restrictions on the number of mental practice trials each subject was allowed, nor does it appear that the subjects were asked to refrain from practicing outside of the laboratory. Nevertheless, this study was one of the pioneering works in this area, and it posed some excellent questions for future research.

Morrisett's (cited in Richardson, 1967b) results which suggested that mental practice is not effective for predominantly motor tasks may have been explained by the lengthy (21 minute) mental practice sessions which the subjects were required to perform, as was previously stated. One of the first studies which suggested that there may be an optimum trial time period was performed by Twining (1949). Using the ring toss as the performance task, Twining had the physical practice group toss the rings 70 times per day for 20 days, and had the mental practice group imagine the task for 15 minutes each day of the 20 days. These groups were compared with a no practice control group. Results indicated that both the mental and physical practice groups performed better than the no practice group. In addition, Twining anecdotally added that after a period of

about 5 minutes, the mental practice subjects lost adequate concentration of the task at hand. Perhaps if one mentally practices a skill any longer than 5 minutes at a time, a process occurs which is analogous to the reactive inhibition which is sometimes seen when a task is physically practiced too long.

A number of studies have looked at the effects of combining mental and physical practice. One of the first of these was done by Trussell in 1952 (cited in Richardson, 1967a). Using three-ball juggling as the performance task, Trussell found that of the five treatment groups, a combined mental practice/physical practice treatment (5 minutes of mental practice per day for the first 6 days; physical practice on the next 14 days) was most effective. This group was next followed by the physical practice only group. The third most effective group utilized a different mental practice/physical practice combination (mental practice on the first 14 days; physical practice on the final 6 days). The mental practice only group was fourth, and the no practice group improved the least.

The subjects' skill level has also been a factor which has generated a substantial amount of research in this area. Clark (1960), for instance, found that novice and junior varsity basketball players showed greater gains in free throw percentage (26% and 23% increases respectively) via

mental practice than did the more skilled varsity players (15% increase). Furthermore, on the average, mental practice was found to be as effective as physical practice for junior varsity and varsity players, while physical practice was overwhelmingly more effective than mental practice for novice players.

Start (1962), on the other hand, found that basketball players rated high on "games ability" showed greater performance increases after mental practice than did those players rated as poor or average. Due to the fact that there is a great deal of inconsistent research on this skill level question, meaningful conclusions cannot yet be drawn.

Corbin (1967a) investigated the effects of mental practice, physical practice, and a mental/physical practice combination on the performance of a completely novel motor task (wand juggling) in order to address the question of whether one must have previous experience with the task before mental practice can be effective. Based on his results, it was suggested that some specific previous experience with the performance task is necessary for mental practice to be effective. This contention was supported in a follow-up study (Corbin, 1967b) where it was demonstrated that when subjects were given previous "controlled" practice of a novel motor skill, mental practice is significantly more effective than no practice. Physical practice,

however, was the most effective practice technique.

In 1968, Surburg studied the effects of different instructional techniques in the training of the forehand tennis drive. Using an audio-visual tennis instruction filmstrip, Surburg divided his subjects into groups which either a) heard only the audio portion of the filmstrip, b) viewed only the video portion of the filmstrip, c) both heard and viewed the entire filmstrip, d) combined the audio portion of the filmstrip with mental practice of the stroke, e) combined the video portion of the filmstrip with mental practice, f) combined the audio-visual filmstrip with mental practice, or g) received no practice whatsoever. Surburg found that overall, the audio/mental practice group showed significantly greater improvement on a standardized tennis performance measure than any other group. The audio-visual/mental practice and visual/mental practice groups were the next most successful groups. None of the other groups were significantly different than the control group. This suggests some effective methods of supplementing mental practice training, and deserves future research. Surburg posed some rather interesting questions in his study, but could have improved his design by substituting an attention placebo control group for the no practice control group. Throughout the mental practice literature, virtually no studies control for subject

motivation factors. If control subjects are given a credible placebo treatment, we might begin to determine whether mental practice is indeed effective, or whether subjects improve because of expectancy for improvement.

One of the parameters of mental practice which has been studied extensively is the "orientation" which the subject takes during the imaging of the skill. Mahoney (1979), in his review of cognitive skills in athletic performance, suggests that mental practice imagery can be categorized as either "internal" (when the subject experiences the phenomenological sensations as if he or she were the participant in the imaginal scene), or as "external" (when the subject experiences the imagery as an external observer or spectator). Davidson and Schwartz (1977) found that subjects who utilized internal, or "kinesthetic" imagery showed greater physiological arousal and less visual activity than subjects who utilized external, or "visual" imagery.

Epstein (1980) attempted to measure the relative effectiveness of internal versus external mental practice on dart throwing. Epstein randomly assigned undergraduate volunteers to either an internal imagery group, an external imagery group, or a distraction control group. Immediately after baseline performance was measured, the treatment subjects were instructed in their respective techniques, and

were told to mentally rehearse the task for two minutes on their own. Then, the second performance measure was taken with 15 seconds of mental practice preceeding each group of three darts. The control group counted backwards as a distraction technique in place of mental practice. Epstein's results indicated that there were no differences between any group on the posttest. These results may be misleading, however, given the very short duration of mental practice training. The majority of studies in this area utilize training periods of one week or more before post-treatment measurement.

Barnes (1982) also studied the internal-external question, and attempted to show that internal imagery is more effective in enhancement of performance than is external imagery. Barnes compared weekly league bowling scores between internal, external, and relaxation imagery groups, and found that none of the treatment groups performed significantly better than a no practice control group. Barnes listed a number of possible factors which may have mediated his results (e.g. subjects' self-reported lack of involvement with the procedures), and therefore the "internal-external" question remains largely unanswered.

Jacobson's (1932) empirical support of an ideomotor (James, 1890; Washburn, 1916) conceptualization of mental practice showed that imagination can evidence itself in physiological activity. as was previously stated. These findings have played a major role in current feedback theories of mental practice. Mendoza and Wichman (1978) alluded to this line of reasoning, and attempted to evaluate the relative value of the "implicit" muscular activity involved in mental practice, as compared with mental practice involving "explicit" muscular activity. To do this. they pretested college undergraduates on a dart throwing task, and assigned the subjects to either a physical practice, a mental practice, a mental practice/simulated physical practice combination, or a no practice control group. The mental practice/simulated physical practice group was instructed to actually simulate the dart throwing motion while they practiced mentally. Results indicated that all three treatments led to significant improvements in dart throwing performance over the performances of control subjects at posttest. Physical practice was significantly more effective than either mental practice conditions and there was no significant difference between the two different mental practice groups. From this study, it can be implied that the implicit muscular activity which Jacobson (1932) measured results in improvement in muscular coordination comparable to the actual overt

practice of those muscular movements. Furthermore, Mendoza and Wichman suggest that immediate feedback or "knowledge of results" as Zecker (1982) might term it, might be the crucial variable which leads physical practice groups to higher levels of performance than mental practice groups.

A variation of the Mendoza and Wichman (1978) study was performed by Zecker in 1982. Using bean bag tossing as his performance measure, Zecker examined the effects of mental practice. physical practice, physical practice without knowledge of results, and control. To prevent knowledge of results in the third group, Zecker extinguished all room lights and presented white noise immediately following the release of the bean bag during practice trials. Results indicated that mental practice was the most effective treatment with about a 30% increase from pretest to posttest. The physical practice without knowledge of results was next at approximately 25% increase, followed by the control group at 15%. Interestingly, the physical practice group showed a 20% performance decrease in performance. Zecker attributed this to a "massed practice" effect and lack of adequate rest periods for this group. From these results, Zecker concluded that knowledge of results is not always essential for improved performance, and that mental practice may be best suited to situations where massed practice learning is required. Again, however,

it appears as though further research is necessary in order to clarify the issue.

The issue of whether the performance task is an "open" or "closed" skill has been alluded to as being important for efficacy of mental practice procedures. According to Gentile (1972), an open skill is defined as a skill in which the environment in which the subject performs the skill is unpredictable. ever changing, and interactive. Sports such as wrestling, basketball, and boxing would be examples of open sports skills. Closed skills, on the other hand are characterized by constant, stable environments. Examples here might be gymnastics, long jumping, or throwing the shot put. With open environments, the athlete must develop a wide repertoire of behavior patterns to match the changing environment, whereas with closed environments, the athlete strives for precise and consistent behaviors. It has been suggested that the use of mental practice techniques may be more beneficial to closed skill athletes as opposed to open skill athletes, precisely because of the stability of the closed environment (Highlen & Bennett, 1979). McBride and Rothstein (1979) attempted to examine the effects of mental and physical practice, alone and in combination. on the acquisition and retention of a paddle ball task which was performed in both an open, and a closed environment. In the closed task, the subjects were required to hit a plastic

golf ball off of a stationary tee at a target. In the open task, the subjects were to hit the ball at the same target, but the balls were dropped from a curved tube at 10 second intervals. McBride and Rothsteins' results indicated that the mental/physical practice combination was the most effective treatment in terms of overall accuracy in both environments. Physical practice alone was next most effective in both environments, and mental practice alone was the least effective treatment in both environments. Finally, overall performance increases were greater in all practice conditions under the closed environment condition. McBride and Rothstein call for further research in this area to clarify questions such as those posed by Highlen and Bennett (1979).

As was previously stated, problems have been seen in many studies on the effects of mental practice where the researchers have failed to equate the frequency of mental practice trials with the number of physical practice trials. One study which attempted to explore this particular problem was performed by Ryan and Simons (1981). Using two novel perceptual-motor tasks (a stabilometer and an Etch-a-Sketch "dial-a-maze"), the experimenters compared the performances of physical practice, mental practice, and no practice groups. The frequency of mental practice trials was indirectly manipulated by allowing the subjects to mentally

rehearse the tasks at their own pace while keeping track of the number of trials they performed. On the predominantly motor task (the stabilometer), physical practice was significantly superior to both the mental practice and no practice groups. On the predominantly cognitive task (the dial-a-maze), the mental practice group performed as well as the physical practice group; both being superior to the no practice group. With respect to the frequency factor, it was found that those subjects who mentally rehearsed the task less frequently performed at higher levels. Anecdotally, the authors reported that these subjects appeared to be attending to a larger number of elements which were essential to the successful completion of the task. In addition, these subjects' concentration appeared to be better and they reported less boredom with the task. These results suggest that the quality of the mental practice may be as important as the quantity. However, since Sackett (1935) reported a trend for higher scores in subjects who performed more mental practice trials, it is apparent that more research needs to be conducted.

Methodological Concerns

Given the vast number of papers of highly variable quality which have been published in the mental practice literature, it is hardly surprising that a number of specific menthodological shortcomings have been reported.

The following is a brief summary of some of these concerns as reported by past reviewers of the literature (Corbin, 1972; Richardson, 1967b; Weinberg, 1982).

Mental Practice Procedures. When one manipulates an internal process such as mental practice, the question of what the subject is really thinking must be asked. Probably the best means of control the experimenter has in what the subject experiences through mental practice is by giving detailed, specific, step-by-step instruction to the subject. Frequently in the literature, experimenters have apparently done no more than to tell the subject to imagine performance of the skill, and then to provide a brief period of silence in which to do so. When procedures such as this are used, the experimenter has no control over either the frequency of mental practice trials, or over the quality of those trials. Even if detailed instruction is given, unless manipulation checks are administered (for a good example, see Weinberg, Seabourne, & Jackson, 1981), the experimenter has very little idea of what the subject actually experiences. The duration of the practice session is another concern which must be addressed when doing this kind of research. As Twining (1949) first suggested, there may be an optimum length of time for a particular practice session, and any procedure over five minutes may lead to problems in attention and concentration. Finally, there appears to be a

great deal of variability in the length of training prior to the post-treatment measurement. Some studies have training periods of an hour or less prior to the posttest, whereas other studies train the subject for three weeks or more. Research on this factor needs to be conducted.

Subject Characteristics. The control of the individual difference factor has always been an important concern for the prudent psychological researcher. In the study of the effects of mental practice, attention must be paid to factors such as skill level, previous task experience, imagery ability (e.g. vividness and controllability), and preferred imagery orientation (e.g. internal versus external imagers). With respect to imagery ability and orientation, there exists a strong need for the development of reliable and valid, between-subjects imagery assessment tools (Kaufman, 1981). Until such tools are developed, the experimental control of such factors will be difficult.

Task Characteristics. Whether the specific task to be performed is primarily motoric, ideational, or perceptual may have profound impact of the efficacy of mental practice. Also, the task which is selected should not provide obvious advantages to one group as opposed to another. For example, one would not want to compare the effects of mental and physical practice in novice weightlifters since physical practice is an inherently advantageous technique over mental

practice for subjects at this skill level with this particular skill. Furthermore, it is important that the task provides a reliable and sensitive measure of performance changes. This problem is highlighted with all-or-none behaviors such as free throw shooting. A great many more trials are needed to provide a good measure of the treatment effects with skills like this as opposed to skills which show fine gradations in performance such as dart throwing or archery. Finally, as Highlen and Bennett (1979) pointed out, whether the task is an open or a closed skill may be an important factor in the efficacy of mental practice.

Motivational Factors. The overwhelming majority of past mental practice research has failed to attend to the effects of motivational factors. If and when control groups are used in these studies, they are typically no practice controls. Results which show that mental practice is as effective as physical practice may simply be due to the fact that mental practice subjects have received the attention of an experimenter and therefore expect to improve. Thus, there presently exists a clear need for studies which use attention placebo control groups. Weinberg, Seabourne, and Jackson (1981) provide an excellent example of how this kind of procedure might be utilized.

Miscellaneous Design Problems. The effects of uncontrolled practice may influence the results of mental practice research. If training periods of over one day are used, the experimenter must attempt to discourage his or her subjects from practicing (either physically or mentally) outside of the laboratory. If a manipulation check is used in the study, a question might be added which inquires about extra-lab practice. Finally, the effects of combining treatments should also be a concern for the mental practice investigator. For example, when combining mental and physical practice, it is possible that it is not the addition of mental practice which leads to better performance over the physical practice-only group. Rather, the effects may be attributable to the fact that mental practice merely "breaks up" the physical practice trials, and thus reduces the effects of reactive inhibition.

General Research Conclusions

Acknowledging the fact that a substantial amount of the mental practice literature is methodologically-flawed and/or relatively unsophisticated, it is difficult to draw firm conclusions or to make confident recommendations for application of these techniques. Nonetheless, it seems important at this time to summarize some of the more robust conclusions which have, to this point, been reached.

First, it appears as though with a number of skills, a combined mental/physical practice approach is probably the most effective technique. The next most effective techniques are physical and mental practice alone, with physical practice typically having a slight edge. Also, mental practice should be used only to supplement physical practice, not to replace it. In this respect, mental practice is perhaps most useful to the injured athlete who is unable to practice physically.

Second, mental practice may be effective because of its demonstrated ability to initiate covert muscular activity. This may lead to improved performance through a type of feedback process which allows coordination to be slowly refined along neural pathways.

Third, it appears that there is an optimal mental practice time interval. Research has suggested that after about five minutes, the subject's attention and concentration may be strained to the point where mental practice loses its effectiveness. Conversely, very short intervals of one minute or so are not as effective as slightly longer intervals (Shick, 1970).

Fourth, some research has suggested that in order for mental practice to be effective, the subject must have some previous physical experience with the task. Perhaps this

helps the learner to establish a mental gestalt or "gross framework" for the task (Corbin, 1972).

Finally, it appears that those who most benefit from mental practice are those who adopt an internal, or kinesthetic perspective, and have vivid, controllable images.

Theory

Theoretical formulations of why mental practice is effective in the performance of motor skills are numerous and diverse. Both Richardson (1967b), and Corbin (1972) provide overviews of some of these theories, but in particular, both include relatively lengthy descriptions of feedback theory. Although the majority of studies in the mental practice literature make no mention of theory, it appears that feedback theory is the most widely cited (Epstein, 1980; Mendoza & Wichman, 1978; Minas, 1978; Sage, 1977; Zecker, 1982), and perhaps holds the most explanatory power of all mental practice theories. In explaining feedback theory, Richardson (1967b) and Corbin (1972) have stated that mental practice may be effective because of the ideomotor, or psychoneuromuscular properties of imagery which James (1890), and later Washburn (1916) described. According to this line of reasoning, imagination of bodily movement promotes covert muscular activity similar to the activity which would occur if the task were actually

being performed, except on a much smaller scale. This minute muscular activity then serves as kinesthetic feedback which the subject utilizes to refine coordination of the task over repeated trials. Richardson (1967b) proposed that this is a process which is similar to the process which may occur in actual physical practice of the task. During physical practice, according to Richardson:

> "When an object is thrown at a target, visual feedback provides information regarding the degree of deviation and kinesthetic feedback provides information regarding the positions of the body musculature that are associated with varying degrees of deviation. As a result of this information corrections are made, and the accuracy of subsequent throws gradually increases" (p. 266).

Richardson noted that when a person imagines the performance of a motor task, he or she produces the tiny muscular innervations which Jacobson (1932) measured. Furthermore, Richardson cites Leuba and Dunlaps' (1951) results which suggest that this kinesthetic feedback is capable of evoking the visual image which is associated with it. With this originally kinesthetic, and now visual-kinesthetic feedback, the person can then (perhaps subconsciously) make the appropriate corrections to improve coordination on the next mental trial.

Using feedback theory as a conceptual guide, the present study posits that this feedback process may be enhanced and enriched through the use of a predominantly "slow motion" rate of mental imagery. The reasoning behind this proposition relates to the efficacy of some current psychotherapeutic techniques (e.g. relaxation techniques, meditation, hypnosis) which emphasize an exaggerated slowing down of the client's information processing. Means (Note 1) emphasizes that these slowing down and focusing techniques may aid in healing through a slow and careful feeding of information to the client. In this way, perhaps details which were once unseen become very clear, and likewise, feelings which were once vague and nondescript, become perspicuous. As related to mental practice, perhaps this same process of slowing down the subject's inner experience can lead to more vivid and clear-cut visual and kinesthetic feedback of the imagined motor task, eventually resulting in improved performance of the motor task. If the mental practice experience is slowed down, it may be less likely that mistakes in execution are overlooked, allowing for adequate correction of the imagined behavior.

Published research on this proposition is not currently available. Some researchers, however, have included some slow motion instructions to their mental practice subjects (Epstein, 1980; Gravel, Lemieux, & Ladouceur, 1980; Suinn,

1972), but this factor has not been subjected to experimental manipulation. There may, however, be some indirect evidence which suggests that slow motion procedures lead to increased performance. It will be recalled that Ryan and Simons (1981) reported that subjects who mentally practiced a motor skill less frequently exhibited higher performance scores than subjects who mentally practiced the skill more often. Although Ryan and Simons did not directly state that these subjects were using slow motion imagery, they did anecdotally report that these subjects often appeared to be attending to more details, of both a visual and kinesthetic nature. Perhaps these subjects were actually slowing down their phenomenological experiences to the point where this feedback was of most value.

A second source of indirect support for the present proposition comes from the hypnosis literature. Hypnosis has long been a technique used by sport psychologists for performance-enhancement (Johnson, 1970). Baer (1980) reported that performance of a video tennis game (Pong) was enhanced through hypnotic time-slowing suggestions in a within subjects ABABAB reversal design. Baer's results can be questioned, however, because of fairly substantial baseline instability, but the study still poses some interesting questions about the effects of slowing down the subject's experience.

Design

The present study was performed according to a variation of the standard paradigm used in most mental practice studies. That is, subjects' performances on a pre-treatment measure were compared to their performances on the same measure at post-treatment. The specific treatments for the present study consisted of standard mental practice (MP) for the first group, slow motion mental practice (SMMP) for the second group, and an attention placebo control (APC) "instructional package" for the third group.

The performance task which was chosen is the "putting" stroke which is involved in the relatively new game of Frisbee disc golf. This game is the flying disc sports analogue to the original ball version of golf. The putting stroke involves a short (usually within ten meters) throw of the flying disc at the "hole", a standardized, basket-like catching device. A putt which lands in the basket is considered a hit, whereas one which does not is considered a miss.

This particular task was chosen for a number of reasons. First, the throwing of a Frisbee disc is a task with which the majority of college students (the subject population for the present study) is relatively familiar. Corbin (1967b) and Hall (1971) suggested that mental

practice is most effective on those tasks with which the subject has some degree of familiarity. Second, when performed in an indoor environment (as this study was), this task is a closed skill. Highlen and Bennett (1979) suggested that mental practice techniques are most effective with closed, as opposed to open skills. Third, this task, unlike a number of tasks reported on in previous studies (e.g. gymnastics, karate), is easily quantifiable and requires no subjective evaluation. Finally, this task has not previously been used as a performance measure in the mental practice literature.

As was previously mentioned, the two treatment groups of interest were a standard mental practice (MP) group and a slow motion mental practice (SMMP) group. The MP group received closely guided mental rehearsal instructions which attended to visual, kinesthetic, and affective components of the experience. The SMMP group received parallel instructions to the MP group, but these subjects were further instructed to experience the majority of their mental practice trials in slow motion imagery. A final group was used as an attention placebo control (APC), to primarily control for motivational and expectancy effects. The APC group met for the same length of time as the MP and SMMP groups, during which they received a "Flying Disc Skills Instructional Package". This included Frisbee disc

promotional films from the Wham-O Manufacturing Company, and also included in-session written instruction of nonspecific Frisbee disc throwing skills. That is, the subjects read about a number of disc throws which require throwing dynamics that are largely different from those involved in disc golf putting.

It is hypothesized at this time that both the MP and SMMP groups will show significantly greater pre- to post-treatment performance increases than the APC group. Furthermore, it is hypothesized that the inclusion of the slow motion practice factor will lead the SMMP group to perform at higher levels than the MP group. Finally, it is hypothesized that the APC group will exhibit marginal performance increases primarily due to the effects of an expectancy for improvement, but that these increases will not approach significance.

Method

Subjects

The subjects were 66 male Introductory Psychology (Psychology 110) students at the University of Montana. Ages ranged between 18 and 31 years ($\bar{x}$=20.97. s.d.=3.31). The subjects voluntarily participated in the present study entitled "Frisbee Throwing" in partial fulfillment of the

experimental credit requirement for Psychology 110. These subjects were randomly assigned to either the MP, SMMP, or APC group.

This sample originally consisted of 84 subjects. Of these 84, 7 failed to complete the study, 1 was dropped at posttest for being admittedly drunk, 1 was dropped at posttest because he claimed to have chopped wood for 5 hours prior to the posttest, and 9 were randomly eliminated after posttest in order to create equal groups for the data analyses.

Apparatus

The primary apparatus used was a standard Frisbee disc catching device which is used in the game of Frisbee disc golf. This Disc Pole Hole (U.S. PATENT NO. 4039189) is manufactured by the Disc Golf Association (D.G.A.), and is constructed of welded and hot-dipped galvanized steel. A full schematic diagram is presented in Figure 1.

Insert Figure 1 about here

Five D.G.A. Kittyhawk golf discs were also used. These discs measure 21 cm. in diameter, and weigh exactly 174 grams each. These are specially designed for use in disc golf putting.

In addition to the abovementioned apparatuses which were used in the pre- and post-treatment phases of the study, two audio cassette players were used for the treatment phase to play the various mental practice instructional tapes. Finally, a 16 mm. film projector was used for the attention placebo group.

Procedure

Pre-Treatment Performance Measurement. Following the initial subject sign-up process and randomization to treatment groups, each subject arrived at a campus gymnasium for an individual pre-treatment performance measurement. This took place on either the Saturday or Sunday immediately preceeding the treatment week. They were greeted by the experimenter and by an assistant who was blind to the experimental hypotheses, and given a brief introduction to the study by the assistant (see Appendix A for complete pre-treatment instructions). Following this introduction, the assistant narrated a brief instruction of the putting motion used in disc golf while the experimenter demonstrated the procedure. After this was done, the subject was allowed five practice throws from the first throwing station, at the end of which, his pre-treatment performance was recorded as he threw five times from each of the ten distances illustrated in Figure 2.

Insert Figure 2 about here

The total number of throws out of 50 which landed completely in the Pole Hole constituted the subject's pre-treatment score. The subject was then thanked and reminded to return on Monday evening to begin the treatment phase of the study.

Upon arrival at the Psychology building on the first night of treatment, the subjects were told to report to one of three classrooms for all treatment sessions. After arriving at their respective classrooms, a roll call was read, and each subject was required to sign a contract which defined the responsibilities of the subject as well as the responsibilities of the experimenter (see Appendix B). Once the contracts were collected, the particular treatments were begun.

Mental Practice Procedure. These subjects received "standard" audio taped group mental practice instruction after having been given an MP rationale by a research assistant (see Appendix C for all instructional scripts). This instruction included a brief relaxation phase in which the subjects were instructed to close their eyes, to assume a comfortable seated position, and to relax to the best of their abilities. This initial relaxation phase was followed by guided visual, kinesthetic, and affective imaginal

practice of the putting throw. One set of three mental practice trials lasted approximately five minutes. Three sets of trials were presented for a total of nine mental practice trials. Each set of trials was separated by an intertrial interval (ITI) of two minutes, during which the subjects were instructed to remain relaxed, but to open their eyes and converse at their leisure. At the end of each ITI the subjects were asked to again close their eyes and relax for the next set of trials. After the second set of mental practice trials, second ITI, and third set of mental practice trials, the group was aroused and given a paper-pencil manipulation check (see Appendix D).

At the end of the treatment session, the group was asked to not discuss the experiment with anyone until the study was completed. They were also asked to not practice the task on their own, either mentally or physically.

This entire procedure was repeated each night of the five night treatment period.

Slow Motion Mental Practice Procedure (SMMP). These subjects received "slow motion" audio taped group mental practice instruction after having been given an SMMP rationale by a research assistant. This group was conducted identically to the MP group, and used virtually the same mental practice script. These subjects were, however,

instructed to experience the second and third trials of each set in slow motion. Therefore, at the end of each treatment session, they had experienced a total of three trials at "normal" speed, and a total of six trials at a slowed rate of speed. The ITI procedure was the same as for the MP group, and at the end of the session, these subjects were given the same paper-pencil manipulation check.

As with the MP group, this group was asked to refrain from discussing the study until its completion and they were also asked to not practice on their own, either mentally or physically.

This procedure was repeated each night of the five night treatment period.

Attention Placebo Control Procedure. This group met each of the five nights for approximately the same length of time as the two preceeding groups. Rather than receiving mental practice instructions, however, this group was given a "Flying Disc Skills Instructional Package" which was purported to lead to an enhancement of Frisbee disc skills. For the first treatment session, and following presentation of the treatment rationale, this group viewed an approximately 25 minute Frisbee disc promotional film that depicts the various disc sports which are included at the annual World Frisbee disc Championships. These films are

not produced with the intention to instruct the viewer on disc skills, but rather, to provide brief exposure to a series of flying disc sports. Following the presentation of the film, the subjects were asked to complete a shortened version of the manipulation check which was presented to the mental practice groups (see Appendix E).

On the second, third, and fourth nights of treatment, the APC group was required to take part in biblio-instruction of flying disc skills. Here, the group individually read exerpts from a book on disc golf. Disc physics and flight characteristics (night 2), the disc golf approach throw (night 3), and the tee shot in disc golf (night 4) were the topics covered. These exerpts are reproduced with the author's permission in Appendix F. Additionally, the manipulation check was administered at the end of these sessions. Finally, on the fifth night this group viewed another Frisbee disc promotional film, and completed the manipulation check for a final time.

As with the mental practice groups, the APC group was asked at the close of each session to refrain from discussing the study with anyone prior to its completion, and to also not practice any of the skills at home.

Post-Treatment Performance Procedure. At the end of the final session, all subjects were asked to sign up for post-treatment measurement on one of the following two days. Upon arrival at the performance site, each subject was then asked to individually perform an additional 50 trials, following a 5 throw warm up period. The verbal instructions which were given at this time are printed in Appendix G. At the end or their respective sessions, each subject was thanked for his cooperation and participation, given his experimental credit, and given a short debriefing handout (see Appendix H).

Results

Pre-post performance results were analyzed with a 3(groups) X 2(repeated measures) Ullrich-Pitz Analysis of Variance (ANOVA). Significance was determined at the .05 alpha level. The analysis revealed no significant group main effect. $F(2,63)=.12$, $p>.05$, but there was a slight, non-significant trend indicating some improvement on the repeated measures factor, $F(1.63)=3.32$, $p=.07$. Although the group X repeated measures interaction was also not significant, $F(2,63)=1.76$, $p>.05$, an inspection of these

results is nonetheless instructive. These results indicated that subjects in the standard Mental Practice group (MP) improved an average of 2.27 hits from pre- to posttest (10.94% increase). In the Slow Motion Mental Practice group (SMMP), there was an average improvement of 1.14 hits from pre- to posttest (5.62% increase). Finally, in the Attention Placebo Control group (APC), there was an average performance decrement of .32 hits from pre- to posttest (1.57% decrease). These results are illustrated in Figure 3.

Insert Figure 3 about here

Upon initial inspection, this figure illustrates what appear to be marked pretest group differences. A separate one-way ANOVA reveals, however, that these differences are not significant, $F(2,63)=.53$, $p>.05$. In addition, the possibility that the lack of group X repeated measures significance was due to an underlying heterogeneity of variance was ruled out with Hartley's FMAX test. $F(1,63)=1.13$, $p\geq.05$.

Analysis of the questionnaire data was performed in two steps. The first step consisted of an analysis of the items common to all three groups (i.e. treatment credibility, subject attentiveness, comprehension of treatment material,

volitional/subliminal extra-session practice). The second step consisted of an analysis of the items common to only the two mental practice groups (i.e. imagery vividness, controllability, internality/externality, rate of imagery, number of mental practice trials).

In the first step questionnaire analysis, a 3(groups) X 5(repeated measures) X 4(items) Ullrich-Pitz ANOVA was performed on the four Likert scale items, and a 3X5X2 ANOVA was performed on the two dichotomous items. Alpha levels were again set at the .05 significance level. A Newman-Keuls multiple comparison analysis revealed no significant between-groups differences on any of these items. Item means across groups indicated that the subjects generally perceived each treatment as being worthwhile in some way, and as being a possible means of enhancing their Frisbee disc skills. Results also suggested that all groups were. on the average, moderately attentive to the instructional procedures, and that they found the material to be highly understandable. Finally, results indicated that a significant majority of all subjects refrained from any extra-session practice, and that only a small percentage of the total sample experienced dreams or daydreams about the procedures. Table 1 contains group means for each of the questions common to the three groups.

Insert Table 1 about here

It is interesting to note that visual inspection of the average values across items 1-4 indicates that the SMMP treatment held the strongest face validity of all treatments ($\bar{x}$=5.46), followed by the APC treatment ($\bar{x}$=5.30), and the MP treatment ($\bar{x}$=5.24). These group differences, however, were not significant, $F(2,9)=.11$, $p>.05$.

In the second step questionnaire analysis, a 2(groups) X 5(repeated measures) X 8(items) Ullrich-Pitz ANOVA was performed on the eight Likert scale items, and a 2X5X2 ANOVA was performed on the two items regarding the number of mental practice trials performed. Again, no significant between-groups differences were found on any of these items at the .05 alpha level. Item means across groups indicated that that a substantial amount of visual imagery was experienced by the participants in the two mental practice groups, that this imagery was moderately vivid, and that this imagery was fairly controllable. Furthermore, across-group means suggested that the majority of subjects in these groups experienced their mental exercises from a predominantly "internal" or player-oriented perspective, and that a moderate amount of kinesthetic sensation accompanied their mental practice. This kinesthetic sensation was

described, on the average, as being moderately intense and was relatively controllable. In addition, the majority of subjects reported that the rate of their imagery was marginally slower than "real life" speed. Finally, results indicated that the average number of mental practice trials which were performed across groups was slightly greater than the number of trials which they were asked to perform ($\bar{x}$=9.17). The number of these shots which were imagined as being "successful" ($\bar{x}$=8.81), was significantly lower than the average number of mental practice trials performed, $F(1,42)=11.68$, $p<.05$. Table 2 contains group means for the items common to the two mental practice treatment groups.

Insert Table 2 about here

Inspection of the average values across items 1-9 (with the values for item 9 inverted to ensure uniform directionality) indicates that the SMMP treatment again had greater face validity ($\bar{x}$=4.73) than did the MP treatment ($\bar{x}$=4.61). These group differences were not significant, $F(1.14)=.11$, $p>.05$.

Discussion

Results indicated that although there appeared to be some performance change in the predicted direction for the two treatment groups. this change was not significantly different from the change demonstrated by an attention placebo control group. These results are not consistent with a substantial body of research which suggests that mental practice. in and of itself, is a significantly effective motor performance enhancement technique (e.g. Clark, 1960; Corbin, 1967b; Mendoza & Wichman. 1978; Ryan & Simons, 1981; Zecker. 1982).

This demonstrated ineffectiveness of both mental practice procedures might be explained in a number of different ways. First, there may have been some specific procedural problems with the present investigation. For example, the mental practice sessions may have been too long, even though efforts were made to break the sessions into individual five minute segments. Twining (1949), it is recalled, stated that the optimal mental practice period should be no longer than five minutes. Perhaps doing three, five minute mental practice segments each session led to some mild reactive inhibition effects. Another potential procedural problem may have been that the mental practice

subjects experienced five sessions of the same audio tape as being rather monotonous and therefore the subjects may have been somewhat inattentive during the sessions. Although the MP and SMMP groups were not significantly less attentive than the APC group on the manipulation check, several subjects did comment on increased monotony from session to session, and a few subjects were observed possibly sleeping in-session. A final procedural problem, and one specifically related to the lack of differences between the MP and SMMP groups, is that the slow motion factor was not seen as being salient to the SMMP subjects. Questionnaire analysis indicated that although SMMP subjects experienced their mental practice as being slower than the mental practice of the MP group, this difference was not significant. Thus, the effects of differences in "speed" of mental practice was not effectively tested in this experiment and awaits further refinements in methodology.

Another major source of potential problems with the present study has to do with subject characteristics. For example, the present results may have reflected the fact that the study was performed on a captive audience, i.e. Psychology 110 students. This is a group of subjects who are required to participate in psychological research, and in the case of this study, they were required to participate for a period of several days. With this in mind, the

results may be partially attributable to low subject motivation. Another subject factor which may have influenced the results is that these subjects were all relatively unacquainted with the specific performance task. Corbin (1967a,b), suggested that specific previous experience with the task is necessary for mental practice to be effective. Although it is probably safe to assume that the majority of subjects in the present study have thrown a Frisbee disc at one time or another, it is unlikely that many of them have ever performed the putting stroke -- a rather specific and unique throwing motion. Furthermore, whether or not 50 pretreatment trials with the task is enough to constitute "acquaintance" remains an empirical question.

A final potential problem to be discussed here concerns the characteristics of the task itself. A substantial amount of performance variability can probably be attributed to the all-or-none nature of the task. For example, a great many strong shots were observed striking the target squarely, only to pass completely through the chains and land (uncounted) on the ground. Granted, this kind of miss occurs frequently on the greens of standard golf courses when putts are struck too firmly, but this knowledge provides little solace to the player who has missed on what he or she feels to be a good shot.

Given the abovementioned potential shortcomings of the present investigation, what might be done to improve the experimenter's chances of demonstrating significant effects in the future? One modification which might be made is to extend the total duration of each session by including longer intertrial intervals. Perhaps this would make the occurrence of reactive inhibition effects less likely. A second procedural change which could contribute to the likelihood of significance is the production of treatment tapes which pull for greater subject involvement. Rather than playing one tape for five different sessions, several different tapes might be recorded, each using a separate script or a different speaker. This might break the monotony somewhat, leading to greater subject attention. With specific regard to further investigation of the slow motion variable, subsequent studies will benefit from extensive pilot work to ensure the saliency of the variable. The present study might also be improved through the use of volunteer athletes instead of Introductory Psychology students. In this way. subject motivation might be more uniformly raised, consequently resulting in potentially more powerful treatment effects. A final, and very important improvement on this experiment concerns the sensitivity of the performance measure. Perhaps the measure which was utilized for this experiment could be made more sensitive to performance change by adding more pre-post trials, by

requiring the subjects to throw from closer distances, or by instating a more graded scoring system (e.g. one point for audible contact with the target, and three points for successful hits).

In conclusion, although this investigation of mental practice effects on the performance of a complex motor skill showed no statistically significant results, it highlights the need to perform further investigations in this area. The study points to the importance of close examination of the methodology and conclusions of past research, and implicates the importance of theory formation in the guiding of future research. In past research, mental practice has been shown to be a potentially valuable tool for the enhancement of sports and motor skills performance. It is the obligation of the researcher to define the specific parameters under which we can best utilize this tool in the pursuit of athletic and motoric excellence. In particular, an effective methodology for assessing performance effects among distinct differences in speed of mental practice has yet to be designed.

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Table 1

Manipulation Check 1

Questions	Group Means MP	SMMP	APC
1) Do you believe that this instructional procedure will be worthwhile to you in any way? (1)Not at all worthwhile, (7)Very worthwhile.	5.03	5.41	5.08
2) Do you think that this instructional procedure will help you become a better Frisbee disc player? (1)Absolutely not, (7)Most definitely.	4.67	5.01	5.15
3) During this particular session, were you able to pay close attention to the information given to you? (1)Extremely inattentive, (7)Extremely attentive.	4.92	4.70	5.16
4) How much of the material presented to you did you understand? (1)None, (7)All.	6.32	6.72	5.81
5) Since our last meeting, have you refrained from practicing these skills as you were told? (1)Yes, (0)No.	0.97	0.94	0.99
6) Have you had any dreams or daydreams about these procedures since our last meeting? (1)Yes, (0)No.	0.15	0.23	0.18

MP = Mental Practice
SMMP = Slow Motion Mental Practice
APC = Attention Placebo Control

Table 2

Manipulation Check 2

Questions	Group Means MP	SMMP
1) Were any particular visual images prompted by this practice session? (1)No visual images, (7)Many visual images.	5.18	5.50
2) If you had any visual images come to mind during this particular practice session, how vivid were they? (1)Not at all vivid, (7)Extremely vivid.	4.85	5.00
3) If you had any visual images, how much "control" did you have over them? In other words, could you make the image do what the tape told you to do? (1)No control, (7)Total control.	4.85	4.95
4) From what "perspective" did you experience these images? In other words, did you "see" from the perspective of a player, or from the perspective of a spectator? (1)Total spectator's perspective, (7)Total player's perspective.	5.46	5.17
5) Were any particular feelings of bodily movement or physical sensation prompted by this practice session? (1)No movement feelings, (7)Many movement feelings.	4.58	4.80
6) If you had any feelings of bodily movement or physical sensation during this practice session, how intense were they? (1)Not intense, (7)Very intense.	4.10	4.17
7) If you had any feelings of bodily movement or physical sensation, how much "control" did you have over them? In other words, could you make yourself feel what the tape told you to feel? (1)No control, (7)Total control.	4.78	5.08
*9) At what "speed" did the majority of your mental experience present itself? (1)Slow motion speed, (7)Accelerated speed.	3.14	3.04
10) How many times did you shoot at the hole in your imagination? _____.	9.32	9.03
11) On how many of these did you make the shot successfully? _____.	8.79	8.84

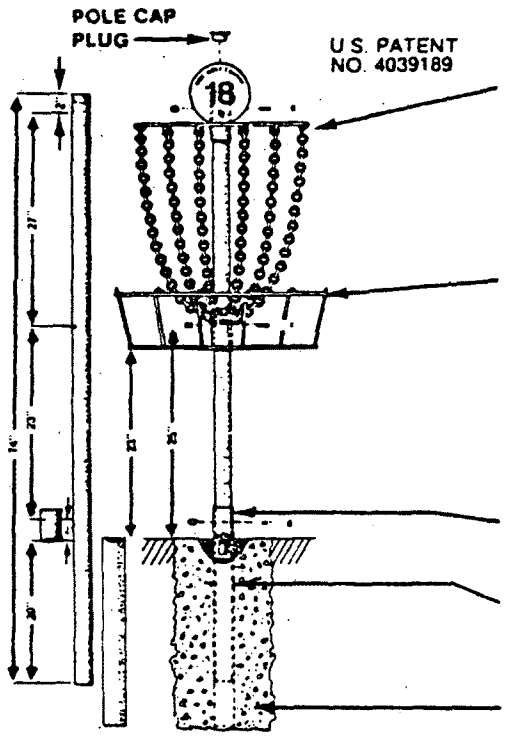
*Item 8 is a free-response item.

Figure Captions

Figure 1. Manufacturer's specifications and schematic drawing of the Disc Pole Hole.

Figure 2. Positioning of throwing stations for pre- and post-treatment measurement.

Figure 3. Mean pre-post treatment group performances.



DISC POLE HOLE® ASSEMBLY

CHAIN ASSEMBLY — welded and hot dipped galvanized.
Hole Sign — 10 gauge steel, 8 in. diameter.
Hole Sign Kit — vinyl numbers and identification cover.
Collar (6 in.) — 2-1/4 in O.D. tubing, .083 wall, drilled.
Bolt, locknut, tech screw & star washer.
Rod Assembly — 3/8 in. steel rod.
Chain — 500 lb. test.

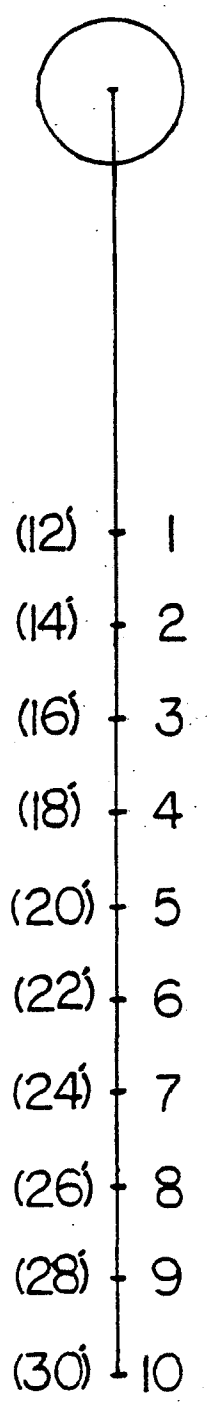
BASKET ASSEMBLY — welded and hot dipped galvanized.
Collar (5 in) — 2-1/4 in. O.D. tubing, .083 wall, drilled.
Bolt, locknut, tech screw & star washer.
Rod Assembly — 3/8 in. steel rod.

POLE (74 in.) — 2 in. O.D. tubing, .120 wall, hot dipped galvanized, drilled.

LOCKING COLLAR — welded and hot dipped galvanized.
Collar (4 in.) — 2 in. O.D. tubing, .083 wall, drilled.
Locking Tab — 3/16 in. steel, punched.
Bolt, locknut, tech screw & star washer.

LOCKING ANCHOR — welded and hot dipped galvanized
Collar (24 in.) 2-1/4 in. O.D. tubing, .083 wall, drilled.
Locking Tab — 3/16 in. steel, punched.

CONCRETE — approximately 1 cubic foot (concrete and lock not furnished).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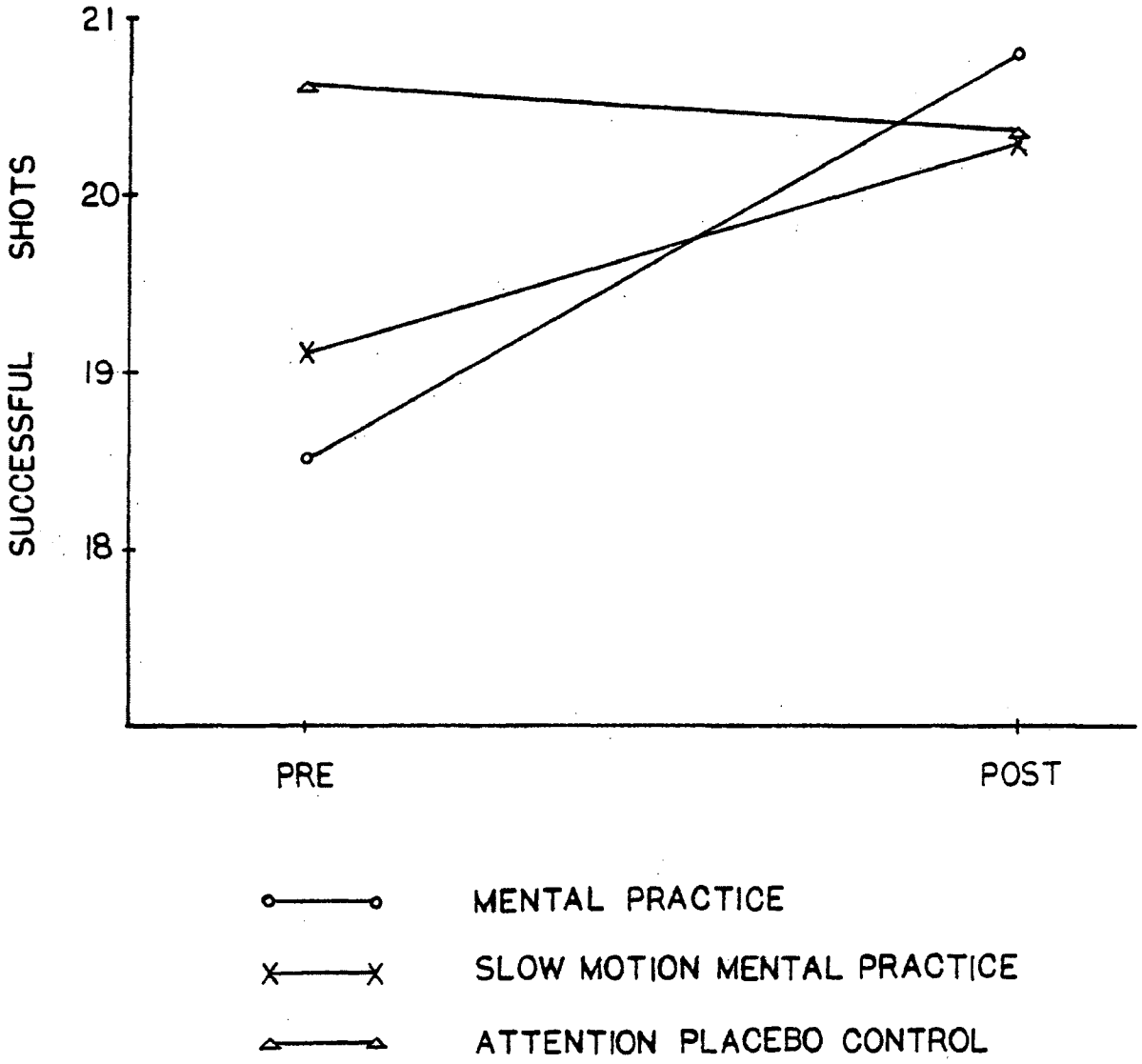
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SUCCESSFUL SHOTS
PRE
POST
MENTAL PRACTICE
SLOW MOTION MENTAL PRACTICE
ATTENTION PLACEBO CONTROL

Appendix A

Pre-Treatment Instructions

Thanks for coming today (subject's name). My name is (narrator's name), and this is (demonstrator's name). You've been asked to come here to learn the putting stroke in Frisbee disc golf. We'd like to first demonstrate two popular methods of the putting stroke, then we'll have you practice this method a few times, and finally, we'd like you to shoot at the hole a number of times from a number of distances.

(Demonstrator) is now going to shoot at the basket and I'd like you to watch and listen carefully as I go through the putting stroke with you. First, obviously, the object is to land the disc in the basket. The easiest way to do this is to strike the chains first, and have the disc fall into the basket below (demonstrate). You may also wish to keep the angle of the disc relatively flat.

Now, we'd like you to go through the motions with us. When you aim at the chains, stand comfortably, about like this . (Strong-side foot is placed about 18 inches in front of the weak-side foot. Each foot points directly toward the hole). Your weight should be balanced.

This is another popular stance (strong-side foot is placed at an open 45 degree angle). Watch as (demonstrator) shoots from this stance (demonstrate). Stand in whichever way you feel most comfortable.

Try to grip your disc like this (thumb on top; fingers fanned underneath). When you're ready, aim and shoot like so (demonstrate). Watch carefully once more (demonstrate).

Now, try it yourself a couple of times. (Pause while the subject takes two shots). If you are more comfortable with a different stance or delivery, throw that way, but if not, use this demonstration as a model. Now, practice the shot three more times. (Pause).

Now we're ready to see how many times you can land in the basket out of 50 throws. Start at the first line, take your time and throw five times as well as you can. After each five throws, move back to the next line until you've shot at each of the ten lines. Please don't worry if you miss the target. Just take your time, do as well as you can, and have fun. We'll retrieve your discs. Any questions? OK, go ahead.

(From this point, the only thing which will be said is "That's fine. Keep trying to do your best" on odd-numbered blocks of five trials, and alternating thereafter with a simple "OK" on even numbered blocks).

(Once the subject is finished). That's all for today. You've done fine. We'd like you to come back in for a short time tomorrow night and each night this week as well for the rest of the experiment. It should be fun for you and should take only 30 minutes or so each night. It's very important that you be there promptly at 8:00 each night in addition to 15 minutes on either next Saturday or next Sunday. At that time, we'll be all done and you will have earned a full seven experimental units. Will you be able to make it each night and either Saturday or Sunday of next weekend? (Reschedule, thank, and dismiss).

Appendix B

Contract

I, _____, agree to attend each of the seven scheduled sessions for the Frisbee Throwing study in exchange for seven units of experimental credit. I understand that if I fail to fulfill this obligation, I will be required to make up twice the number of units which I miss. I also understand that it is as important for me to not discuss this experiment with anyone until its completion, as it is for the experimenter to not discuss the specifics of my participation with anyone not affiliated with the experiment.

Experimental Participant

Experimenter

Date

Appendix C

Treatment Scripts

Mental Practice Group

Live Introduction: Session 1. Before we begin, I'd like to thank you all for coming tonight, and I'd also like to explain a bit about why you are here. This past weekend, you were all introduced to Frisbee disc golf by practicing the putting stroke on one of the standard target devices which are used in the game of disc golf -- the Disc Pole Hole. Tonight, and the rest of this week, what we would like to do is to teach you a way to practice this putting throw mentally, as opposed to physically. This technique will allow you to practice with your imagination, instead of with your body. Research has shown that practice like this leads to improved skill performance. For tonight and for the next four nights, I'll play an audio tape for you with step-by-step instructions for your mental practice. On either Saturday or Sunday, we will try to see how much you've improved as a result of this practice. Please listen carefully to the tape, and perform these mental exercises to the best of your ability. Also, please practice along with the tape so that everyone mentally practices the same number of throws. Let's begin. (Continue with taped instructions

below).

Live Introduction: Sessions 2-5. Thanks again for coming tonight. We're going to be doing some more mental practicing this session in order to see if it will affect your disc skills. Again, please listen carefully to the tape and do the exercises as best you can. Also, please only do as many mental practice trials as the tape instructs you to do. Let's begin. (Continue with taped instructions below).

Taped Introduction and Relaxation. You are about to be led through a series of mental exercises designed to improve your skills in disc golf. If you become adept at the technique presented to you here, you can apply it to other sports if you wish. I will be giving you instructions for about the next 15 minutes or so in three, five minute segments, and I would like you to listen to and concentrate on each word that I speak. In order for this exercise to be a successful one, it is important that you attend only to the words which are spoken, and that you block out any thoughts which may come to you which do not directly relate to the instructions which I am giving. Since we will be working in short segments, you should be able to put all your efforts into concentration without becoming too fatigued.

Before we begin, please assume a comfortable position in your chair and close your eyes. (Five second pause). Relax. Take a deep breath and hold it for several seconds. (Five second pause). Now exhale. Again, inhale deeply and hold. (Five second pause). Exhale. Feel the relaxation and comfort. Concentrate on that feeling of relaxation, and block all thoughts which aren't related to my words. We're now ready to practice the putting stroke. Once again, concentrate!

Taped Mental Practice. I would like you to imagine yourself back at the gymnasium. You are there alone to practice putting. You see the Pole Hole -- your target. You pick up three discs which are laying by your feet, and notice that they are three equally weighted golf discs. The weight in your hand feels good and gives you a feeling of confidence. You walk to the first throwing line -- 12 feet from the hole -- a short distance. You are very confident in your abilities. You now begin to focus on the target. You see each link in sharp contrast against the blurred background. You see the center pole and the basket as well. Twelve feet. You now place two of the discs on the ground because you wish to shoot at the hole. The disc feels heavy and stable in your throwing hand. There is also a coolness in the plastic which soon begins to dissipate as your hand and the disc become one. You toe the throwing line and

continue your concentration. You almost immediately become aware of all your body's sensations. Each muscle used in the throw seems to be aligning itself with the task. They prepare for a smooth, accurate stroke. You are relaxed, yet poised and confident. You focus on the target as your body shifts into automatic. You aim at a particular link in one of the center chains. You assume the stance which is most comfortable to you as you continue to concentrate. You now take some practice strokes with the disc firmly in hand -- one, two, three. You sight the target and feel the confidence and concentration build. You are now ready. Still focusing, you begin the stroke by curling your wrist. Your wrist tightens as it cocks the disc. You feel a sense of smooth balance as you transfer your weight back. Like the coiling of a spring, your body readies itself, reverses the weight transfer, and smoothly thrusts forward, snapping your throwing hand forward and cleanly spinning the disc toward the hole. The flight is brief. The angle is just right, the power is just right, and the disc strikes the chains firmly, breaking the silence. You feel a great sense of accomplishment as you gaze upon the disc in the basket. You mentally record each feeling from this perfect throw and attempt to duplicate it with another throw.

You pick up the second disc. It too feels stable in your hand.

Your attention again becomes rivited on the hole. This time, you want the throw to be even more automatic than before. You control the disc in every way and you know that you can hit the target easily by simply recalling each feeling and image promoted by your last throw. Just as before, you feel a strong sense of confidence as you toe the line. You once more focus intensely on a link in the center chain as your body's sensations begin talking to you. Each muscle reports a readiness as you take practice strokes with the disc firmly in hand -- one, two, three. You are ready. With a steady aim, you curl your wrist back. As it tightens and cocks the disc, your weight rocks back -- coiling the spring. In an instant, your weight thrusts forward, smoothly pushing the disc out of your snapping hand toward the target. The flight is again straight, and again the silence is broken as the disc hits the chains. You pick up the last disc and toe the line once more. One last shot. This time, you feel such confidence that you feel as though the disc were magnetic and that all you have to do is remember your last throws, release the disc cleanly, and it will be drawn to the target by itself. You take aim and become fully aware of your bodily sensations. As you ready yourself, you take three practice strokes -- one, two,

three. You are ready. With intense focus on the target you curl your wrist and rock your weight backwards. In an instant you drive forward and cleanly spin the disc toward the hole. The flight is once more a satisfying one since the angle and power were perfect. You've made your third shot; the last of this series. You may now open your eyes for a brief rest period. Please feel free to speak with your neighbor if you wish.
(Two minute break).

Please close your eyes again and concentrate once more on my words. I would like you to relax yourself again to the best of your ability. Take a few deep, full breaths. Get very relaxed and calm, so that you can attend to each word I speak, and to each image that you see.

Let's go back to the gymnasium now. You are there alone, and you wish to practice some more. This time, you pick up the discs and walk to the third throwing line. This line is 16 feet from the hole. You toe the line. You now put two discs down. Although this distance is farther than before, you have confidence in your abilities. The target is once again in sharp focus as you concentrate on your link in the chain. You gradually tune out all external distractions and you become acutely aware of all the feelings in your body. Your muscles begin to align themselves with the throw. From head to toe, you ready

yourself. You've again made note of the increased distance, and mentally record the slight increase in power which you will need. The weight of the disc feels good in your hand. You sight the target, assume your stance and begin your practice strokes -- one, two, three. You feel ready and confident. You automatically cock the disc back into your wrist and transfer your weight back. In an instant, your weight changes and you thrust the disc toward the hole with a complete followthrough. It flies to the target and strikes the extreme right chain, nearly missing the basket. To your relief though, it does tumble in. You note this near miss and recognize that your aim was slightly off because you released the disc too late. You correct this mistake in your mind and seek to refine the release on your next throw. You value and utilize the feedback from every throw to refine your stroke.

You pick up the second disc. It too, feels good in your hand and its stability prompts your confidence. You again toe the line and assume your throwing stance. Your body shifts into automatic with the mental imprints of each successful throw as your guide. You rely on these memories to refine your skill with each trial. From your comfortable stance, you sight the target over the top of the disc. Your grip feels secure yet relaxed, your stance is balanced and stable, and your mind is clear and focused. With disc in

hand, you execute your practice strokes -- one, two, three. All is ready now. All is positive. You curl the disc into your wrist as you rock back. When you hit the stops, you immediately transfer your weight forward, extending your arm and wrist and propelling the disc toward the hole. It floats toward the target, strikes the chains with an audible clang, and drops into the basket. Again, a feeling of accomplishment spreads through you. You mentally record each part of the throw; how it felt, looked, and resulted, and you seek to duplicate it with each shot.

You now seek to follow this mental groove, much like a turntable stylus follows the grooves in a record. You once more attend to the target as you reach for the last disc. As you gently grip the disc, you recall the feelings. You concentrate and ready yourself. One, two, three practice strokes. Focus. You cock your wrist and shift your weight back. You then fluidly reverse your weight and drive the disc to its destination. Your eyes do not leave the target, and the disc follows their aim and strikes the chains, dropping the disc easily into the basket. You feel a sense of mastery and pride in your skills. Mentally record each movement of your stroke, the flight of the disc, and the end result of the successful throw.

In a few moments, we will practice one final set of throws, but before we do, please feel free to open your eyes, and speak with your neighbor for a few moments. (Two minute break).

Let's resume our mental practice one more time. Please close your eyes, assume a comfortable position in your chair, and relax again with full, deep breaths. Once more, concentrate to the best of your ability on my words and ignore any irrelevant thoughts which might intrude into your awareness.

Please imagine that we are back at the gymnasium for more practice. You have already retrieved your discs from the last series of throws, and you walk to the fifth throwing line. This line is a full twenty feet from the hole. You make mental note of the increased distance over your last throws, and you make plans to compensate for this distance increase with an increase in power. You set two discs on the floor, and assume a comfortable stance. You are still relatively confident in your ability to hit the target from this distance, yet you mentally prepare yourself in the possible event of a miss. You prepare to learn from potential mistakes. Still, you feel quite confident. The target is in sharp focus. You choose your aiming point and focus on it intently. All outside distractions fade as you become aware of your body, the disc, and the hole. Each

muscle reaches a state of readiness. You take a deep breath and begin your practice strokes -- one, two, three. You coil the disc into your wrist and ease your weight backwards. You immediately drive your body, arm, and the disc toward the hole with ample spin. It travels briefly through the air and strikes the chains, falling into the basket below. Each time you throw, the groove gets deeper and your motion is refined. You seek the groove again with your second throw.

You pick up your second disc and feel its weight in your hand. You are again confident.

The target is in clear focus as you step once more to the line to assume your stance. The stance is comfortable and balanced, and as you sight the target, you again become aware of each of the many sensations in your body. You know the exact positioning of each limb without even looking. Each body part knows the proper sequence to perform, and waits in anticipation of the throw. Everything is on automatic as you concentrate even more on your chosen link in the chain. Focus. Three practice strokes now -- one, two, three. You are ready. The tension in your curling wrist signals the weight transfer backwards. With the disc cocked at the end of your backstroke, you thrust your weight and the disc toward the hole. An audible snap of your fingers sends the disc toward the target. It strikes the

basket instead of the chains, skips upwards into the chains and finally comes to rest inside the basket. You process this near miss, and note that the next throw will require a minute increase in power. Learn from your mistakes and correct each error in execution. You refine the groove and follow it with each successive throw. Although you were close to missing the mark on the last throw, you feel confident in your ability to do better this next time.

You pick up your last disc. You toe the line and make one more mental note of the distance. Twenty feet. You must slightly increase the power to ensure that you hit the hole. Your muscles ready themselves as you assume your stance. You intently focus on the target over the top of the disc and breathe deeply. All is ready. You take three practice strokes with the disc securely in hand -- one, two, three. You cock the disc into your wrist as you wind the spring backwards. The weight on your rear foot signals the shift forward, and you drive the disc at the hole. The power, angle. and aim are perfect as it is guided into the basket. You can feel proud that you are able to learn from your mistakes and adjust your performance accordingly. Remember each of the throws you've made today and use them to refine the groove in your mind. It is in this way that we make physical practice perfect, and it is also the way in which we make mental practice perfect. This kind of

practice can be effective for you if you allow yourself the time and concentration to make it work. Refine the groove in your mind so that when you do actually throw again, you will have a guide to follow. This is all the practice which we need to do today. Please open your eyes and wait for your closing instructions.

Live Concluding Instructions. Before you go, I'd like you to please complete this short questionnaire (MP manipulation check) as best you can. When you are through, you are free to go. Please remember to return tomorrow, and please follow all instructions at the end of the questionnaire. Thank you.

Slow Motion Mental Practice Group

Live Introduction: Session 1. (Same as MP group).

Live Introduction: Sessions 2-5. (Same as MP group).

Taped Introduction and Relaxation. (Same as MP group).

Taped Slow Motion Mental Practice. I would like you to imagine yourself back at the gymnasium. You are there alone to practice putting. You see the Pole Hole -- your target. You pick up three discs which are laying on the floor by your feet and notice that they are three equally weighted golf discs. The weight in your hand feels good and gives you a feeling of confidence. You walk to the first throwing

line -- 12 feet from the hole -- a short distance. You are very confident in your abilities. You now begin to focus on the target. You see each link in sharp contrast against the blurred background. You see the center pole and the basket as well. Twelve feet. You now place two of the discs on the ground because you wish to shoot at the hole. The disc feels heavy and stable in your throwing hand. There is also a coolness in the plastic which soon begins to dissipate as your hand and the disc become one. You toe the throwing line and continue your concentration. You almost immediately become aware of all your body's sensations. Each muscle used in the throw seems to be aligning itself with the task. They prepare for a smooth, accurate stroke. You are relaxed, yet poised and confident. You focus on the target as your body shifts into automatic. You aim at a particular link in one of the center chains. You assume the stance which is most comfortable to you as you continue to concentrate. You now take some practice strokes with the disc firmly in hand -- one, two, three. You sight the target and feel the confidence and concentration build. You are now ready. Still focusing, you begin the stroke by curling your wrist. Your wrist tightens as it cocks the disc. You feel a sense of smooth balance as you transfer your weight back. Like the coiling of a spring, your body readies itself, reverses the weight transfer, and smoothly thrusts forward, snapping your throwing hand forward and

cleanly spinning the disc toward the hole. The flight is brief. The angle is just right, the power is just right, and the disc strikes the chains firmly, breaking the silence. You feel a great sense of accomplishment as you gaze upon the disc in the basket. You mentally record each feeling from this perfect throw and attempt to duplicate it with another throw.

You pick up the second disc. It too feels stable in your hand. Your attention again becomes rivited on the hole. This time, you want the throw to be even more automatic than before. Also, I'd like you to perform these next throws as if they were in slow motion so that you can closely attend to each part of the throw. Slow the experience way down and feel the movement in each body part. You control the disc in every way and you know that you can hit the target easily by simply recalling each feeling and image promoted by your last throw. Just as before, you feel a strong sense of confidence as you toe the line. Again. slowly. Keep it very slow. You once more focus intensely on a link in the center chain as your body's sensations begin talking to you. In slow, methodical sequence, each muscle reports a readiness as you take deliberate practice strokes with the disc firmly in hand -- one -- slow, two -- slower, three -- slower still. You are ready. In slow motion , concentrate. More focus. With a steady aim, you

slowly curl your wrist back. As it gradually tightens and cocks the disc, your weight rocks slowly back -- slowly coiling the spring. In time-slowed sequence, your weight gradually thrusts forward, smoothly pushing the disc out of your snapping hand toward the target. The flight is so slow and straight that you can see each revolution on the disc. Again the silence is broken as the disc hits the chains.

You pick up the last disc and toe the line once more. One last shot. This time, you feel such confidence, that you feel as though the disc were magnetic and that all you have to do is remember your last throws, release the disc cleanly, and it will be drawn to the target by itself. Again, in very slow motion, you take aim and become fully aware of your bodily sensations. As you ready yourself, you take three easy practice strokes -- very slowly now -- one, two, three. You are ready. With intense focus on the target you slowly curl your wrist and easily rock your weight backwards. Feeling as if you were moving underwater, you drive forward, inch by inch, and cleanly spin the disc toward the hole. The flight is once more a slow and satisfying one since the angle and power were perfect. You've made your third shot; the last of this series. You may now open your eyes for a brief rest period. Please feel free to speak with your neighbor if you wish.

(Two minute break).

Please close your eyes again and concentrate once more on my words. I would like you to relax yourself again to the best of your ability. Take a few deep, full breaths. Get very relaxed and calm, so that you can attend to each word I speak, and to each image that you see.

Let's go back to the gymnasium now. You are there alone, and you wish to practice some more. This time, you pick up the discs and walk to the third throwing line. This line is 16 feet from the hole. You toe the line. You now put two discs down. For this first throw, you will experience each phase of the stroke in life-like speed again. Although this distance is farther than before, you have confidence in your abilities. The target is once again in sharp focus as you concentrate on your link in the chain. You gradually tune out all external distractions and you become acutely aware of all the feelings in your body. Your muscles begin to align themselves with the throw. From head to toe, you ready yourself. You've again made note of the increased distance, and mentally record the slight increase in power which you will need. The weight of the disc feels good in your hand. You sight the target, assume your stance and begin your practice strokes -- one, two, three. You feel ready and confident. You automatically cock the disc back into your wrist and transfer your weight back. In an instant, your weight changes and you thrust the disc toward

the hole with a complete followthrough. It flies to the target and strikes the extreme right chain, nearly missing the basket. To your relief though, it does tumble in. You note this near miss and recognize that your aim was slightly off because you released the disc too late. You correct this mistake in your mind and seek to refine the release on your next throw. You value and utilize the feedback from every throw to refine your stroke.

You pick up the second disc. This time, slow the motion down again, and concentrate on each part of the throw. This disc too feels good in your hand and its stability prompts your confidence. You again methodically and slowly toe the line, deliberately assuming your throwing stance. Your body shifts into automatic with the mental imprints of each successful throw as your guide. You rely on these memories to refine your skill with each trial. From your comfortable stance, you sight the target over the top of the disc. Keep the experience slow. Your grip feels secure yet relaxed, your stance is balanced and stable, and your mind is clear and focused. With disc in hand, you slowly execute your practice strokes -- one -- slow, two -- slower, three -- slower still. All is ready now. All is positive. You gradually curl the disc into your wrist as you rock back. Keep it slow. When you hit the stops, you slowly transfer your weight forward, extending your arm and

wrist and propelling the disc toward the hole. It gently floats inch by inch toward the target, strikes the chains with an audible clang, and gently drops into the basket. Again, a feeling of accomplishment spreads through you. You mentally record each part of the throw; how it felt, looked, and resulted, and you seek to duplicate it with each shot.

You now seek to follow this mental groove, much like a turntable stylus follows the grooves in a record. You once more attend to the target as you reach for the last disc. As you gently grip the disc, you recall the feelings. Slow the feelings way down and carefully attend to each sensation. You concentrate and ready yourself. Focus. Again in slow motion, you take one, two, three practice strokes. More focus. You gradually cock your wrist and deliberately shift your weight back. Keeping it very slow, you then fluidly reverse your weight and slowly drive the disc to its destination. Your eyes do not leave the target, and the disc gently spins, turn by turn, follows your aim and strikes the chains, dropping the disc easily into the basket. You feel a sense of mastery and pride in your skills which spreads like a slow wave through your body. Mentally record each movement of your stroke, the flight of the disc, and the end result of the successful throw. Again, keep it slow.

In a few moments, we will practice one final set of throws, but before we do, please feel free to open your eyes, and speak with your neighbor for a few moments. (Two minute break).

Let's resume our mental practice one more time. Please close your eyes, assume a comfortable position in your chair, and relax again with full, deep breaths. Once more, concentrate to the best of your ability on my words and ignore any irrelevant thoughts which might intrude into your awareness.

Please imagine that we are back at the gymnasium for more practice. You have already retrieved your discs from the last series of throws, and you walk to the fifth throwing line. This line is a full twenty feet from the hole. You make mental note of the increased distance over your last throws, and you make plans to compensate for this distance increase with an increase in power. For this first throw, try to experience each phase of the stroke in real life speed. You set two discs on the floor, and assume a comfortable stance. You are still relatively confident in your ability to hit the target from this distance, yet you mentally prepare yourself in the possible event of a miss. You prepare to learn from potential mistakes. Still, you feel quite confident. The target is in sharp focus. You choose your aiming point and focus on it intently. All

outside distractions fade as you become aware of your body, the disc, and the hole. Each muscle reaches a state of readiness. You take a deep breath and begin your practice strokes -- one, two, three. You coil the disc into your wrist and ease your weight backwards. You immediately drive your body, arm, and the disc toward the hole with ample spin. It travels briefly through the air and strikes the chains, falling into the basket below. Each time you throw, the groove gets deeper and your motion is refined. You seek the groove again with your second throw.

Now, slow the motion way down so that you are aware of every detail of the throw. Make it very slow and very deliberate. You pick up your second disc and feel its weight in your hand. You are again confident.

The target is in clear focus as you slowly step once more to the line to purposely assume your stance. The stance is comfortable and balanced, and as you sight the target, you again become aware of each of the many sensations in your body. In this decelerated state, you know the exact positioning of each limb without even looking. Each body part knows the proper sequence to perform, and waits in anticipation of the throw. Everything is on automatic as you continue to slow down the experience and concentrate even more on your chosen link in the chain. Make it very slow. Focus. More focus. Three slow practice

strokes now -- one, two, three. You are ready. The slow tension in your curling wrist signals the gradual weight transfer backwards. Feeling each motion in a greatly decelerated rate, and with the disc cocked at the end of your backstroke, you slowly and purposely thrust your weight and the disc toward the hole. An audible snap of your fingers sends the disc easily toward the target. The disc inches its way to the target. Spinning. Spinning. It strikes the basket instead of the chains, gently skips upwards into the chains and finally comes to rest inside the basket. Keeping the experience slow, you process this near miss, and note that the next throw will require a minute increase in power. Learn from your mistakes and correct each error in execution. You methodically refine the groove and follow it with each successive throw. Although you were close to missing the mark on the last throw, you feel confident in your ability to do better this next time.

You pick up your last disc. Again, be very slow and feel the throw. You toe the line and make one more mental note of the distance. Twenty feet. You must slightly increase the power to ensure that you hit the hole. This time, reduce the speed of the throw even more than before and attend to each element of the motion. Your muscles ready themselves as you ease into your stance. You intently focus on the target over the top of the disc and breathe

deeply. Focus. All is ready. You take three deliberate practice strokes with the disc securely in hand -- one -- slow, two -- slower, three -- slower still. You cock the disc into your wrist as you gradually wind the spring backwards, inch by inch. The weight on your rear foot signals the slow shift forward, and you unhurringly drive the disc at the hole. The disc floats along its path. Floating. Floating. The power, angle, and aim are perfect as it is guided into the basket. You can feel proud that you are able to learn from your mistakes and adjust your performance accordingly. Remember each of the throws you've made today and use them to refine the groove in your mind. It is in this way that we make physical practice perfect, and it is also the way in which we make mental practice perfect. This kind of practice can be effective for you if you allow yourself the time and concentration to make it work. Refine the groove in your mind so that when you do actually throw again. you will have a guide to follow. This is all the practice which we need to do today. Please open your eyes and wait for your closing instructions.

Live Concluding Instructions. (Same as MP group).

Attention Placebo Control Group

Live Introduction: Session 1. Before we begin, I'd like to thank you all for coming tonight, and I'd also like to explain a bit about why you are here. This past weekend, you were all introduced to Frisbee disc golf by practicing the putting stroke on one of the standard target devices which are used in the game of disc golf -- the Disc Pole Hole. Tonight, and the rest of this week, what we would like to do is to teach you something about flying disc skills through films and selected readings about Frisbee disc sports. We believe that this teaching format may be of great value in helping players to improve their skills without actually playing. Tonight and Friday night, we will view short films on the World Frisbee disc Championships. On Tuesday, Wednesday, and Thursday nights, you are required to return here to read about some of the skills which you will see in the films. Then, on either Saturday or Sunday, we will try to see how much you've improved through this teaching technique. Please pay very close attention to all the information which is presented to you tonight and the remainder of the week. Let's begin.

Live Introduction: Sessions 2-5. Thanks again for coming tonight. We're going to be doing some more instruction on flying disc skills. Please, while reading (viewing) this chapter (film), we'd like you to pay very close attention to all the information which is presented to you. It is only in this way that we can truly measure the effectiveness of this teaching method. Let's begin.

Live Concluding Instructions. (Same as MP and SMMP groups, but using the APC manipulation check).

Appendix D

Mental Practice Manipulation Check

S.S. Number:_____

1) Were any particular visual images prompted by this practice session?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Many Visual Images; 4=Some Visual Images; 1=No Visual Images)

2) If you had any visual images come to mind during this particular practice session, how vivid were they?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Extremely Vivid; 4=Moderately Vivid; 1=Not At All Vivid)

3) If you had any visual images, how much "control" did you have over them? In other words, could you make the image do what the tape told you to do?

|-------|-------|-------|-------|-------|-------|
1 2 3 4 5 6 7

(1=No Control; 4=Moderate Control; 7=Total Control)

4) From what "perspective" did you experience these images? In other words, did you "see" from the perspective of a player, or from the perspective of a spectator?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Total Player's Perspective; 4=Half and Half; 1=Total Spectator's Perspective)

5) Were any particular feelings of bodily movement or physical sensation prompted by this practice session?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Many Movement Feelings; 4=Some Movement Feelings; 1=No Movement Feelings)

6) If you had any feelings of bodily movement or physical sensation during this practice session, how intense were they?

|-------|-------|-------|-------|-------|-------|
1 2 3 4 5 6 7

(1=Not Intense; 4=Moderately Intense; 7=Very Intense)

7) If you had any feelings of bodily movement or physical sensation, how much "control" did you have over them? In other words, could you make yourself feel what the tape told you to feel?

|-------|-------|-------|-------|-------|-------|
1 2 3 4 5 6 7

(1=No Control; 4=Moderate Control; 7=Total Control)

8) Very briefly, please describe any feelings that you may have had.

9) At what "speed" did the majority of your mental experience present itself?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Accelerated Speed; 4="Real Life" Speed; 1=Slow Motion Speed)

10) How many times did you shoot at the hole in your imagination during this session? _____.

11) On how many of these did you make the shot successfully? ____.

12) Do you believe that this instructional procedure will be worthwhile to you in any way?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Very Worthwhile; 4=Moderately Worthwhile; 1=Not At All Worthwhile)

13) Do you think that this instructional procedure will help you become a better Frisbee disc player?

|-------|-------|-------|-------|-------|-------|
1 2 3 4 5 6 7

(1=Absolutely Not; 4=Possibly; 7=Most Definitely)

14) During this particular session, were you able to pay close attention to the information given to you?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Extremely Attentive; 4=Moderately Attentive; 1=Extremely Inattentive)

15) How much of the material presented to you did you understand?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=All; 4=Some; 1=None)

16) Since our last meeting, have you refrained from practicing these skills as you were told?

yes __ no __

17) Have you had any dreams or daydreams about these procedures since our last meeting?

yes __ no __

Please remember to return for your next session at the appointed time. Please do not discuss this experiment with anyone until its completion. Finally, please do not practice in any way the skills which have been presented to you here. Thanks for your help, and we will see you tomorrow.

Appendix E
Attention Placebo Manipulation Check

S.S. Number:_____

1) Do you believe that this instructional procedure will be worthwhile to you in any way?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Very Worthwhile; 4=Moderately Worthwhile; 1=Not At All Worthwhile)

2) Do you think that this instructional procedure will help you become a better Frisbee disc player?

|-------|-------|-------|-------|-------|-------|
1 2 3 4 5 6 7

(1=Absolutely Not; 4=Possibly; 7=Most Definitely)

3) During this particular session, were you able to pay close attention to the information given to you?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=Extremely Attentive; 4=Moderately Attentive; 1=Extremely Inattentive)

4) How much of the material presented to you did you understand?

|-------|-------|-------|-------|-------|-------|
7 6 5 4 3 2 1

(7=All; 4=Some; 1=None)

5) Since our last meeting, have you refrained from practicing these skills as you were told?

yes __ no __.

6) Have you had any dreams or daydreams about these procedures since our last meeting?

yes __ no __.

Please remember to return for your next session at the appointed time. Please do not discuss this experiment with anyone until its completion. Finally, please do not practice in any way the skills which have been presented to you here. Thanks for your help, and we will see you tomorrow.

Appendix F

Attention Placebo Biblio-Instruction[1]

CHAPTER 1

DISC PHYSICS

How is it possible to throw a disc farther than a baseball? A ball is hardly a wing, however, much to the surprise of a lot of would-be-aerodynamicists, it is an aerodynamic device. An overhand pitch with the fingers on top of the ball can actually climb above its natural gravitational flight. This little known fact was something utilized by the Chinese and later by a gentleman named Magnus in 1853. The ball is spinning with a back-spin and the air pressure on the bottom of the ball is higher than the pressure on the top, as is the case with a wing in flight. This pressure differential causes the ball to rise. It is also what causes the curve to curve, and the crazy flight of the no spin spit ball, hence, The Magnus Effect (force). See Figure 1.

A properly thrown disc can easily outdistance a thrown ball because of its wing-like characteristic. As the forward speed slows, the pull of gravity actually provides most of the energy for the last quarter of the flight. The disc "glides" to earth. The baseball, conversely, is in effect falling from the time it leaves the thrower's hand,

[1]Reprinted with permission of the author, Ed Headrick, from Throws and Strategy of Tournament Play for the Game of Disc Golf. 1984.

FIGURE 1

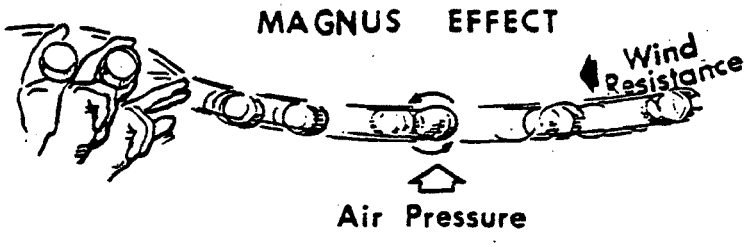
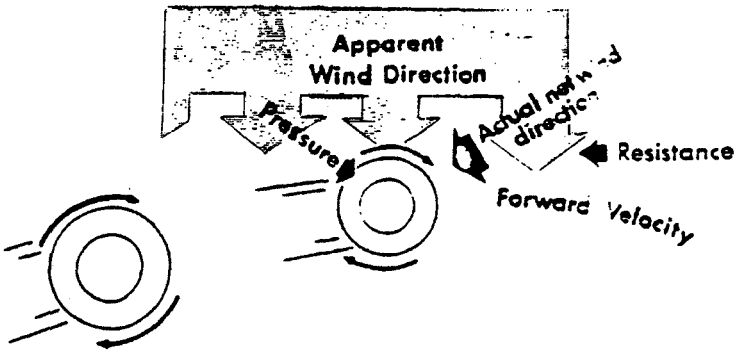


FIGURE 2



at a rate of approximately 32 fps/ps. Even the Magnus effect only partially slows its rate of descent. The disc thrown backhand with the wind from left to right is also assisted by the Magnus force which, in this case, actually pushes the disc as its forward motion slows. See Figure 2.

Life would indeed be simple if all the distance players and disc designers had to worry about was the Magnus effect. A disc flies something like a wing of an airplane and is stabilized by its gyroscopic characteristics. The conditions and forces that combine to cause this free flying wing, that is only 8 to 12 inches in diameter, to fly directly to its target 100 yards away are so compound that modern science has, as yet, failed to explain this phenomenon of flight. Every effect described in subsonic aerodynamics applies to the disc. High speed stall, low speed stall, Bernoulli effect, Magnus, etc., and one more that airplanes don't usually have to worry about, Precession. This is the effect that causes one of the poles of a gyroscope to move 90 degrees in the direction of the spin away from a force applied to the pole. See Figure 3.

When a disc is launched, its shape presents an airfoil to the passing air -- a center of lift is quickly established. The catch is, the center of lift is not the center of the disc. In fact, it isn't even on the center line of the disc. On a right hand backhand throw it is to

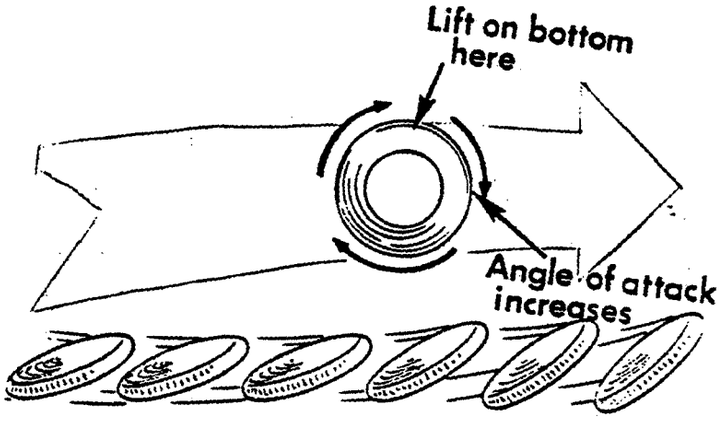
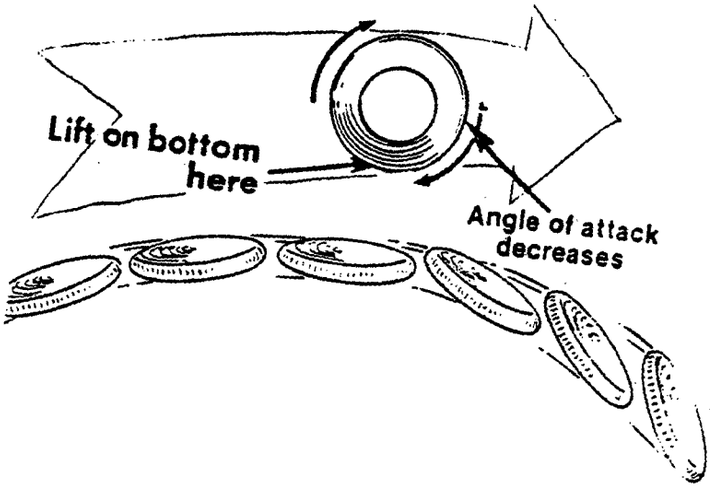

Lift on bottom here
Angle of attack increases

FIGURE 3


Lift on bottom here
Angle of attack decreases

the left of the center line and behind the center of the disc. This astable lift is felt by the gyroscope as being a force attempting to raise the rear of the disc which causes the left edge to try to raise. Impact lift strikes the underside of the flight plate and coupled with an apparent high speed stall on the lifting surface, balances the precession force. Note: This phenomenon is the prime reason for increasing the tilt to the left as launch velocity is increased. The disc is momentarily stable, in balance, and the flight appears to be controlled. The dynamics affecting the flight of the disc are far from static and are. in fact, in a state of constant change. The disc slows dramatically in the first 20 feet and as it slows, the center of lift changes. As it changes, the precession force changes. Without pursuing the continuing fluid change to infinity, let's go ahead to the point where the disc has lost most of its forward speed (aerodynamic lift), but is still spinning. At this point, most stable discs begin to drop like a parachute and land flat or tail first.

Some discs, the ones best for distance, fly in a soft "S" curve. flat with a slow curve to the right, then a slow recovery to the left. These discs are astable (see Figures 4, 5), because of the shifting center of lift, and instead of parachuting to a landing, usually land in a glide with

FIGURE 4

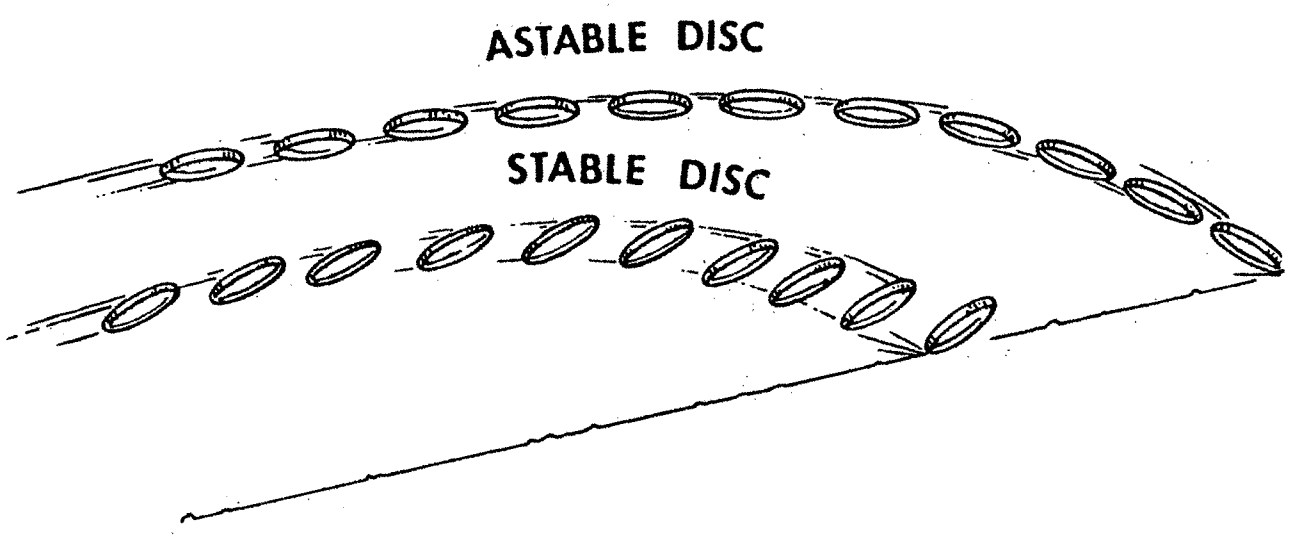
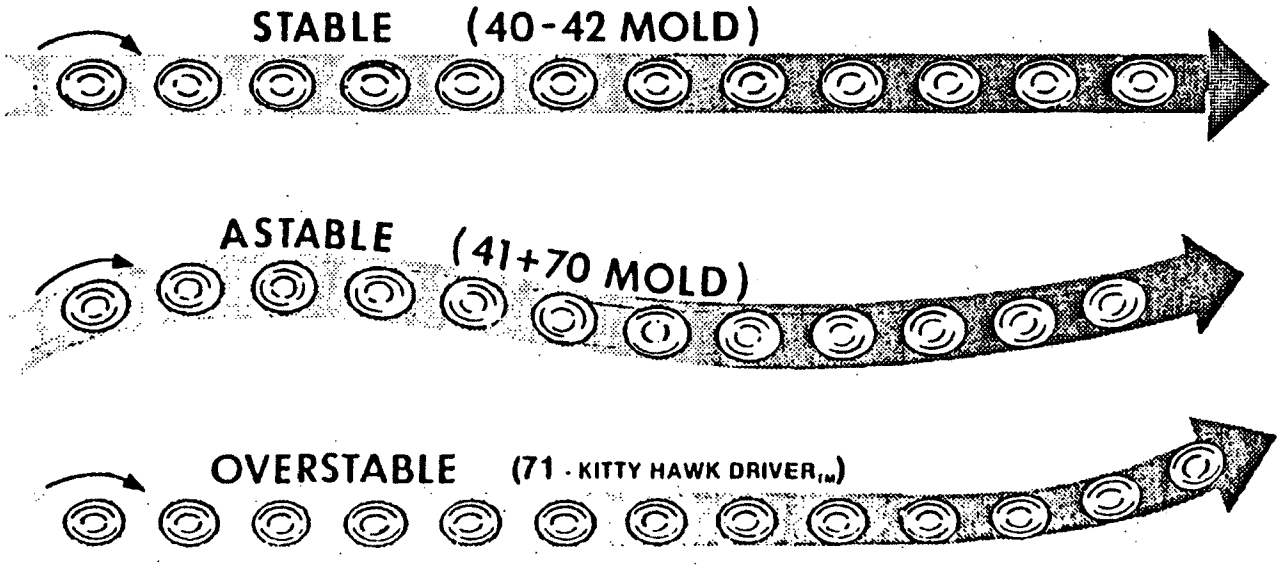


FIGURE 5


STABLE (40-42 MOLD)
ASTABLE (41+70 MOLD)
OVERSTABLE (71 - KITTY HAWK DRIVER™)

the leading edge striking the ground first. This glide can improve the distance by 5 or 10%.

If all of this sounds complicated, imagine the complexity of a throw or launch that compensates for all the flight characteristics of the disc, the wind, air temperature and altitude, etc., and propels the disc 100 yards or more, accurately! Distance throwers practice their form and technique for hours every day and have usually worked for several years before they break the 100 yard barrier. A good form, the correct disc and practice, practice, practice!

NOTE: All spins are reversed if thrown left handed.

Wind tunnels only test some of the flight characteristics of a disc. The constantly changing center of lift, for example is almost impossible to test except in free flight. Perhaps, when a free flight wind tunnel is developed, the disc can be substantially refined. Until then, we have to observe the disc in flight to determine its flight characteristics.

The best test procedure you can follow, unless you are a tireless distance player, is to find a hill with about a 10% grade. Take the discs you want to test to the top of the hill and pick an aiming point that will cause your disc to be launched at a slightly negative angle, i.e., a glide

angle. The launch is the same as gliding a model airplane, except for an exaggerated spin. If the disc turns over to the right, launch it with more tilt to the left. See Figure 6.

A 40 mold manufactured between 1978 and 1982 will normally strike the ground at the same angle it was launched. This disc is called a "stable" disc and has no equal. A 41 mold made during the same period will, when launched at the same angle as a 40 mold, come up to a flat angle at mid flight and turn slightly to the right. At a point approximately 20 % from landing, it will turn back to the left with an increased glide angle. This is an "astable", or unstable disc. The 70 mold has a similar but more gradual unstable flight characteristic.

An "over-stable" disc is one which, after launched, continues to turn to the left. Some good M.T.A. (maximum time aloft) and T.R.C. (throw, run and catch) Fastback discs have this characteristic. The more it slows, the more it turns. The self-caught flight (M.T.A. and T.R.C.) disc follows a glide pattern after it has reversed direction much the same as the down hill test glide. Once you have mastered the proper launch, you will be able to easily observe your disc in a flight pattern that closely resembles the last half of a distance throw.

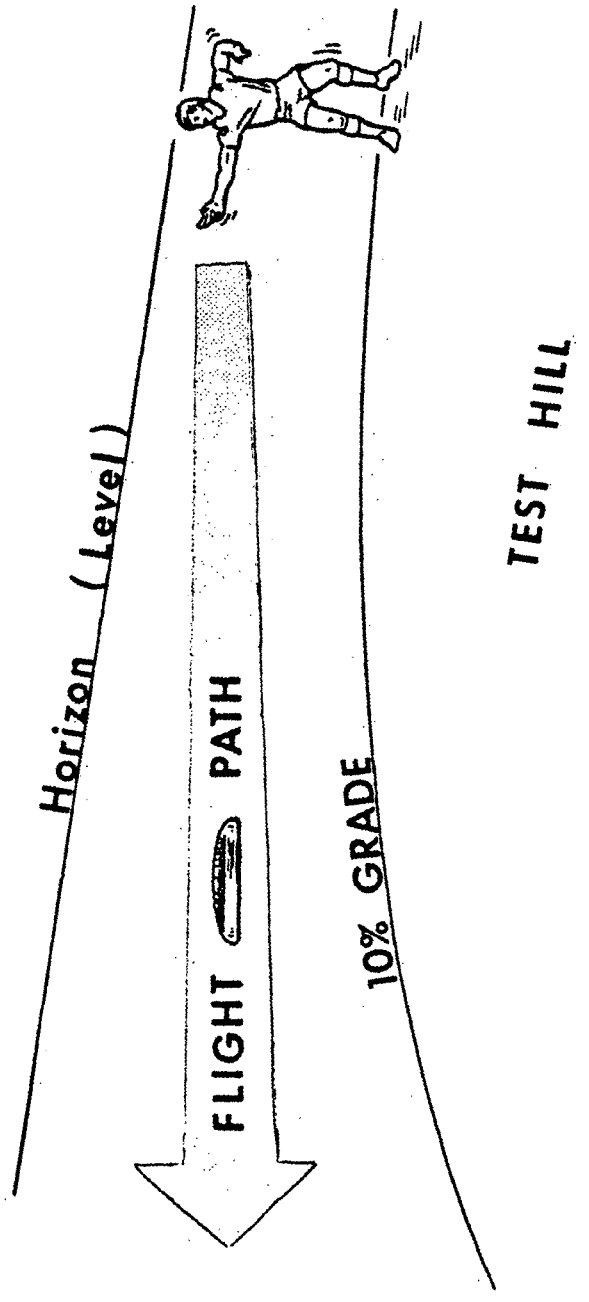
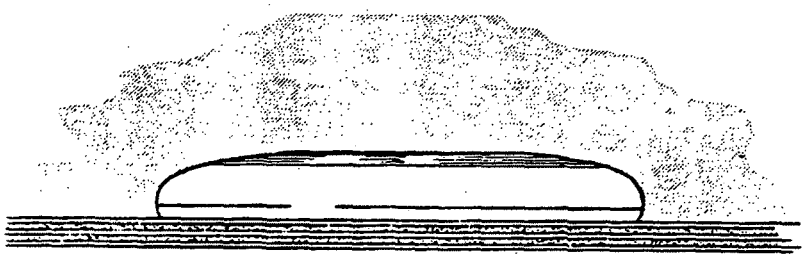


FIGURE 6

The weight can also be tested in this manner and may surprise you. A light 41 mold will often out-distance a 40 mold that is 20 or 30 grams heavier. Conversely, a heavy 41 mold thrown downwind may not be the best choice.

Take your throwing stock on a hill and learn how they fly. Then apply this knowledge to your game. The right disc at the right time can make all the difference. Before you throw any disc in test, be sure you adjust it to "dead flat." Check it on a flat piece of plywood or something that is convenient and flat (see Figure 7). Throw the disc a few times until you have recorded its flight characteristics, then twist it into a slight warp. Now throw it again. Different flight? That is why you should always check your disc for "flat" before you throw it in competition. Surprises lose tournaments!

FIGURE 7



CHAPTER 2

THE APPROACH THROW

When approaching the hole from the fairway (over 10 meters from the hole), a medium range throw must be used. If the hole is clear of hazards and obstructions, the throw is similar to the throw used when playing catch. There is however, one noticeable exception. The Disc Pole Hole cannot reach out or run after a missed throw.

Generally, every approach throw should be made with the intent of "holing out". How aggressively you "go for it" should depend on your score. If you miss on a firm throw, you may be faced with another approach shot instead of a putt. The throw that is safest is one that will cause the disc to pass through the catch zone of the hole while the disc is about to land. If you miss on this throw, the disc should still be within 10 or 15 feet from the hole. This is called a drop throw. See Figure 8.

There are several ways to accomplish a drop throw. The easiest and most controllable is a modification of the air bounce. Aim the throw beneath the target and aim the disc above the target.

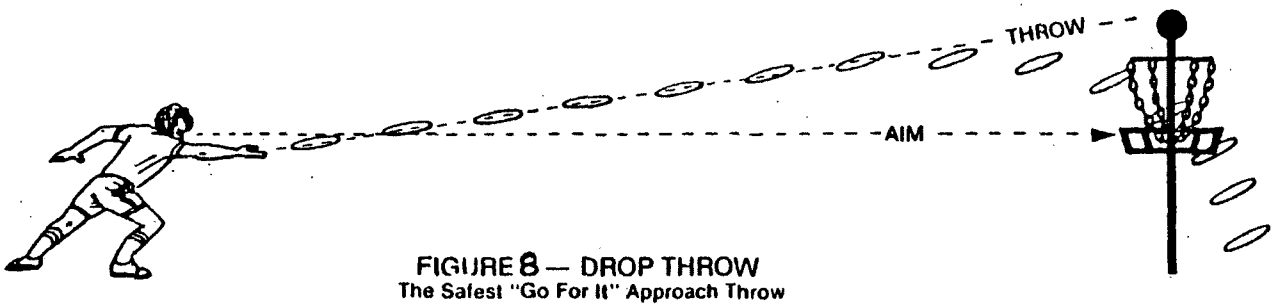


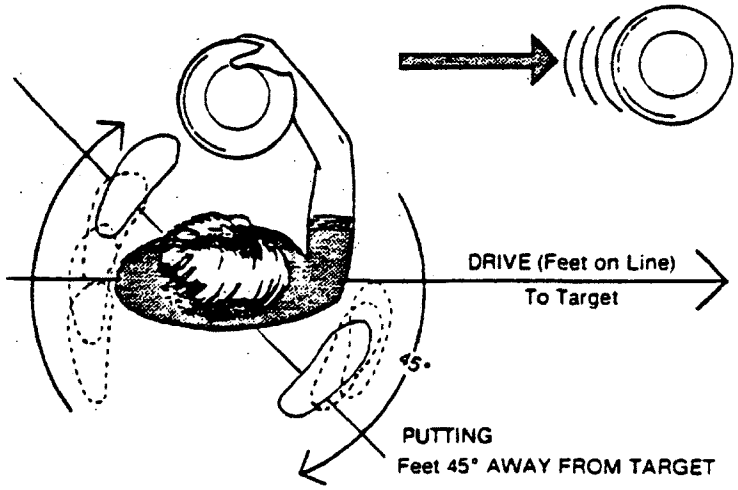
FIGURE 8 — DROP THROW
The Safest "Go For It" Approach Throw

This requires a slight modification of the backhand grip. Shift the thumb so that the pressure comes off of your index finger and is felt by all of your fingers equally. The angle of the disc relative to the line of throw (angle of attack) can be easily varied by shifting the thumb forward or backward on the flight plate (top of the disc).

The stance should be opened up dependent on the power required to make the throw go the correct distance. Full power approaches are made with both feet on a line drawn from the hole through your lie. The left foot should be moved forward progressively as the amount of power is reduced. When you are within putting range, your stance should have opened up to approximately 45 degrees. See Figure 9.

The drop throw requires a good spin because the disc is almost in a stall for the whole flight. If the spin is weak, it may lack the gyro stability required to keep the disc flat through the whole flight. If the disc loses spin too soon, it will generally take a radical turn to the left as it runs out of forward motion. The grip should otherwise be as soft as possible to avoid holding on too long or causing excessive hand drag at the time of release.

FIG. 9 STANCE & FOOT PLACEMENT



A disc thrown backhand that lands flat or slightly tilted to the left will usually hug the ground and stop with no roll. If it tilts right on landing, it will probably roll and it is difficult to predict where it will stop.

The wind around the hole will have to be carefully considered before attempting a flat drop throw. If the wind is in your face, extreme angles of attack should be avoided. In fact, the more wind, the less angle required. Don't ever let the disc go with a negative angle unless you intend to aim substantially above the hole (described in more detail in "negative angle throws"). Too much angle may cause the disc to boomerang or fall off radically to the left.

Conversely, wind blowing from behind your line of flight will cause your disc to apparently drop more rapidly than you had planned, so the more tail wind, the higher the aiming point, and the more head wind, the lower the aiming point. You will also have to adjust the amount of power used to the velocity of the wind. As a tail wind increases, power should decrease. As a head wind increases, power should increase.

The primary reason for this phenomenon is the relative velocity of the disc as it is launched (leaves your hand). If you assume your normal approach throw would launch the disc in flight at 15 miles per hour and there is a 5 mile

per hour head wind, the relative launch velocity is 20 miles per hour. The ground speed is reduced to 10 miles per hour. The flying time to the target has been increased by 33%! If the power is not increased, the disc will surely land short, and of equal importance, if the spin is not increased proportionately, the disc will start to turn over to the right at the moment of launch. If the same tail wind is coming from behind you, a 15 mile per hour launch velocity now has a net air speed of 10 miles per hour, and a ground speed of approximately 15 miles per hour for most of its short flight. The disc is flying and dropping as if it had been thrown at 10 miles per hour. This will cause the drop rate to increase by 33%. This throw will fool your senses because, except for the radical drop, it looks like you did everything correct. It takes a lot of will power, but the proper thing to do is aim higher and reduce power. The resulting flight path will look like a very soft lob shot with the midpoint substantially higher than the point of contact with the hole. Remember this throw if you have a down wind approach over low hazards in front of the hole. It is impressive even if it misses because if properly thrown. it will have lost enough relative velocity to fly and will therefore drop on the trajectory of a thrown rock.

Cross winds will move the disc in the direction the wind is blowing in an amount directly proportionate to its velocity and the time the disc is airborne. If the wind is perpendicular to your line of flight and coming from the right, the disc will move to the left (see Figure 10). If your throw was launched at 15 miles per hour and the hole is 50 feet away, it will be in the air from four to seven seconds.

If you inadvertently get the right edge up with the wind from the right, the disc will balloon and will exceed the velocity of the wind to the left, as its thrown velocity turns in that direction. Get your track shoes to retrieve this one. Conversely, if the left edge is up, the disc will drop like in a tail wind and will still be off to the left. If you compensate with more tilt to the right, the disc can be thrown in a relatively straight line, but will land on the right edge and roll. In a 5 mile per hour wind it may roll a long way.

If the wind is from the left, the opposite rules apply. However, if you get the left edge up it will again land on the right edge and roll. The difference is, with the wind from the left, it will be under the rolling disc and may blow it out of the park.

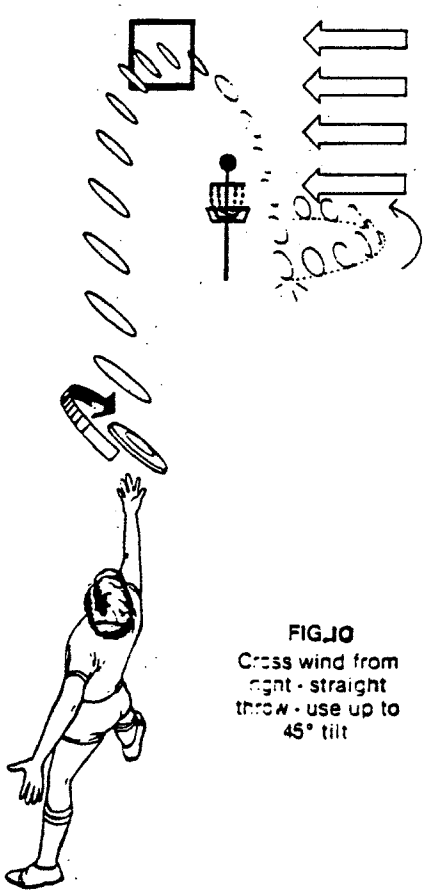


FIG.10
Cross wind from right - straight throw - use up to 45° tilt

Hazards between you and the hole may cause a different kind of an approach. The left hand curve is the easiest to control, therefore, it is perhaps the safest throw except in a cross wind from the right (see Figure 11). The amount of curve you put into the disc at time of launch will be the angle the disc hits the ground if the disc is stable. With a left curve. the edge of the disc that hits the ground first will be spinning the opposite direction to the flight path. When the disc contacts the ground, it will normally do a quick button hook to the left and lay down. The worst that usually happens is a short skip flight with a left button hook.

If you are forced into a right curve and are throwing a stable disc, launch the disc as close to flat as you can and still accomplish the amount of curve required. A disc with a right hand spin naturally wants to turn to the right. Therefore, if you get the left side up too high, it will land on its right edge which is spinning in the direction of flight. This will usually result in an uncontrolled roll.

If the hazard is so large that the curve will have to pass around an object that is as far away from the straight line to the hole as you are from the hole, a right curve is your best option. It can be accomplished with a stable disc by launching with an almost imperceptible angle to the right and good spin. Aim beyond the hazard and up at about 30

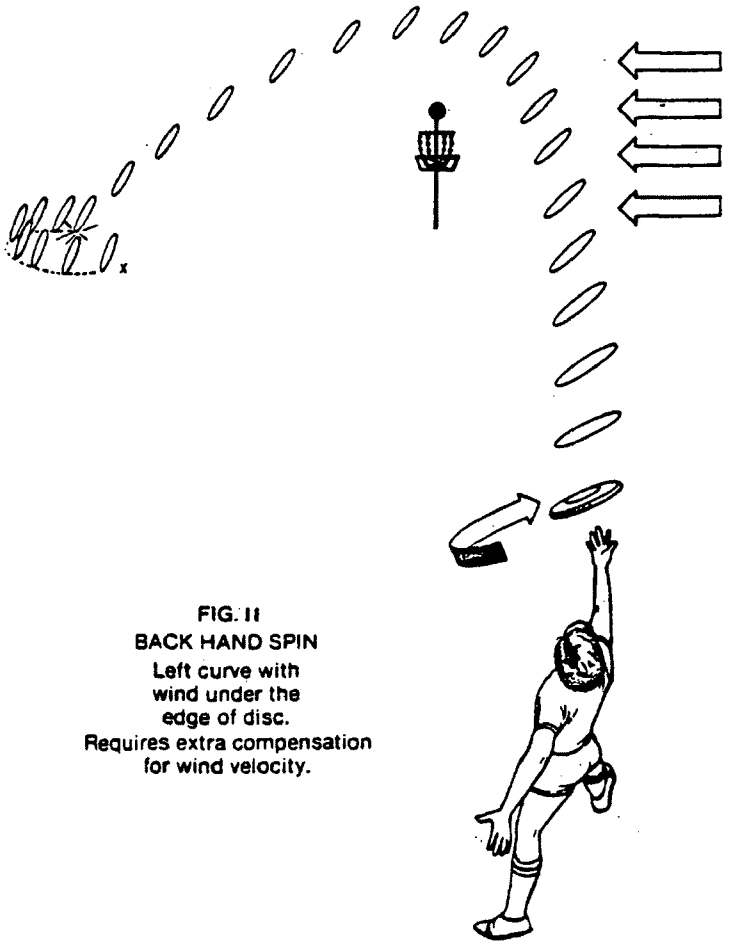


FIG. 11
BACK HAND SPIN
Left curve with
wind under the
edge of disc.
Requires extra compensation
for wind velocity.

degrees from the horizon. If properly thrown, the disc will fly in almost a straight line to your window in the sky beyond the hazard. It will then make a right turn that can exceed 90 degrees and glide in an almost straight line to the target (see Figure 12). This throw can be accomplished in any wind direction as long as the wind is light. As the wind gets stronger, its affect on the throw increases to the point where it may be difficult to control.

A left curve will not come back as far as a right curve and will not make a straight, curve, straight flight pattern. The maximum curve resembles a "U" flight path and has very little glide in flight. Therefore, it takes a lot more power to reach its objective. With practice, the disc will skip and pick up an additional 20 or 30 feet, but this is extremely difficult to control. Wind from the right will help, if it is strong enough. In this case, the disc is launched close to dead flat with a slight angle to the left. The aiming point is 30 degrees above the horizon and just beyond the hazard. The disc, if thrown correctly, will appear to stall and the wind will blow it back to the left. This is a difficult throw to control. See Figure 13.

There is an exception. An unstable disc, one that turns to the right naturally, is capable of a flight path similar to the right hand curve shown in Figure 12, and is the best disc to use on a maximum curve.

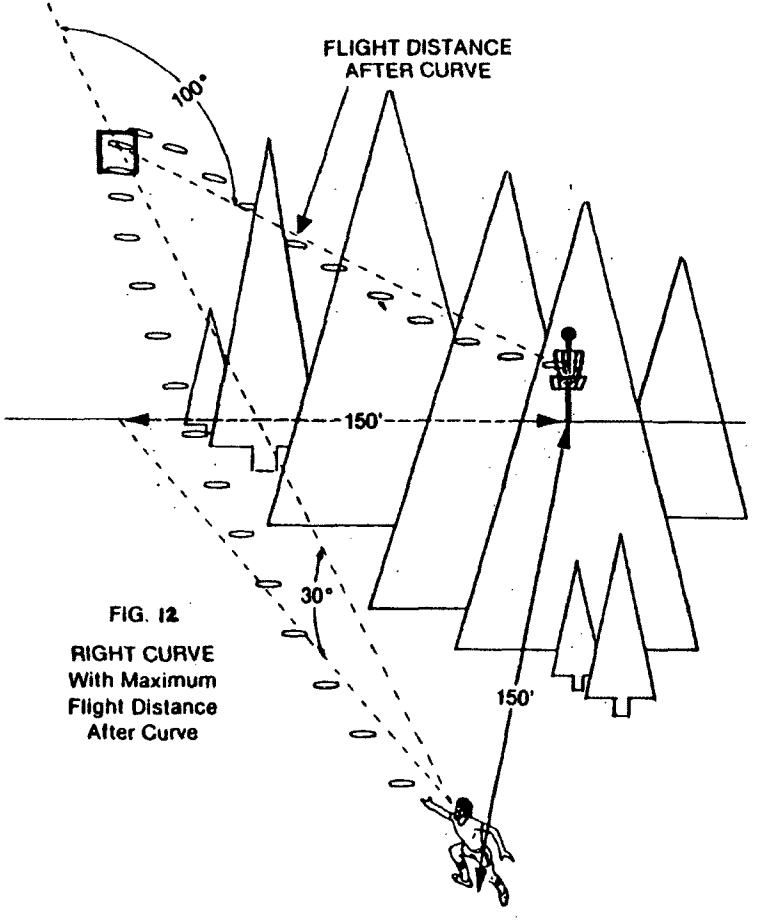


FIG. 12

RIGHT CURVE
With Maximum
Flight Distance
After Curve

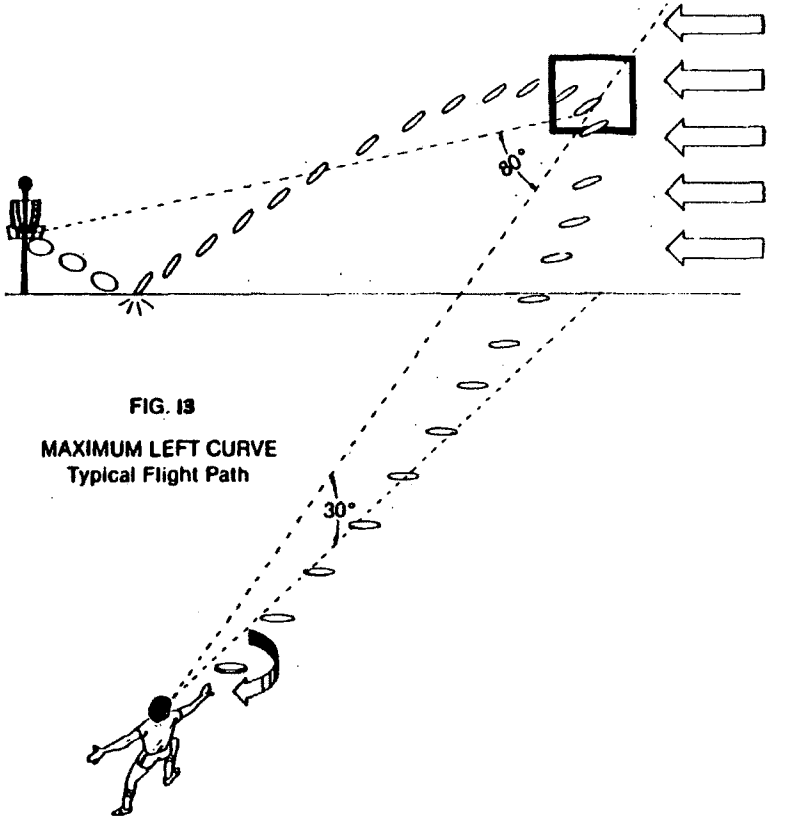


FIG. 13

MAXIMUM LEFT CURVE
Typical Flight Path

Another very effective right curve throw is a modification of the upside down throw. Start with a side arm grip and launch the disc approximately vertical with an overhand throw (like a baseball pitch). The disc should be aimed to the left of the target and aimed at a window approximately 30 degrees above the horizon. The disc will turn upside down. As its forward motion slows, it will curve right and land upside down. On smooth ground, it will normally slide between 5 to 10 feet. This is also an excellent throw when the only way out of a hazard is up. Use the same grip and overhand style but keep the disc slightly more than vertical at launch. The flight path will resemble a thrown rock, and is reasonably consistent even with a fairly strong wind. See Figure 14.

The side arm launch (see Figure 15) is a good approach throw, however, unless you are an accomplished side armer, backhand is safer and more controllable. There are times when your lie is located where you have no choice, so you should have a side arm in your inventory. Remember the flight characteristics are the reverse of a backhand throw because the spin is opposite.

The overhand wrist flip (see Figure 16) is a must when your lie is so close to a hazard that you can not clear it with a backhand or side arm throw and you need some distance. The point of launch is between 1 and 2 feet

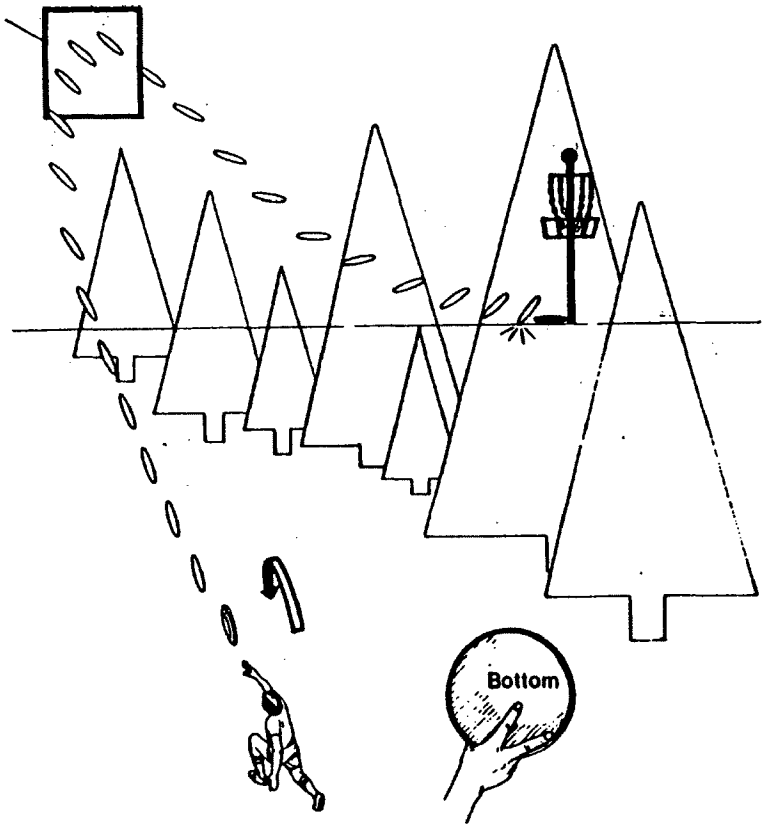


FIG.14 UPSIDE DOWN APPROACH THROW

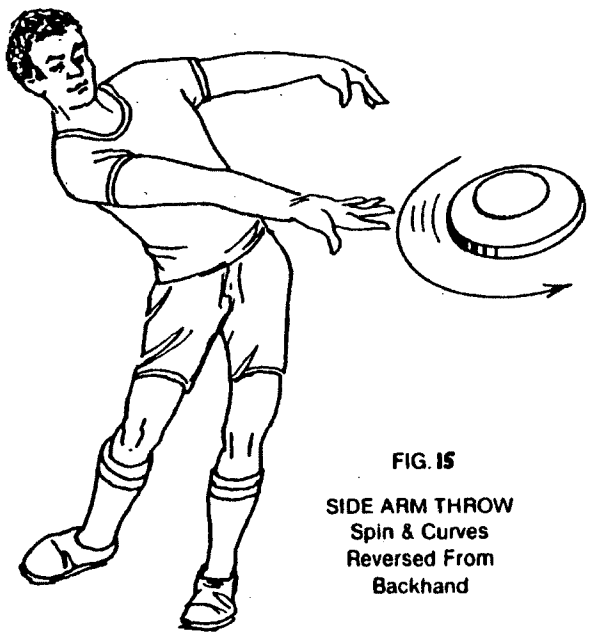


FIG. 15

SIDE ARM THROW
Spin & Curves
Reversed From
Backhand

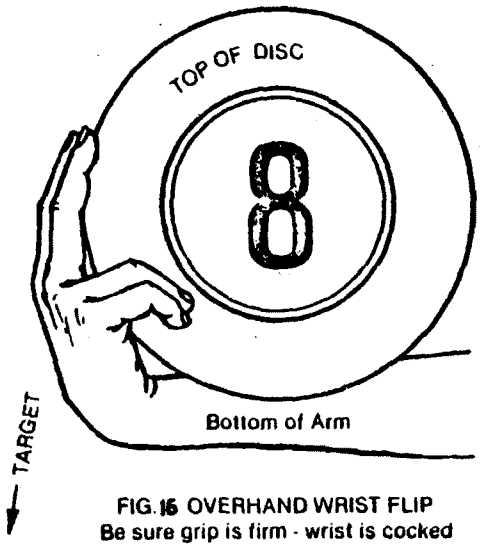


FIG. 16 OVERHAND WRIST FLIP
Be sure grip is firm - wrist is cocked at maximum and arm is straight

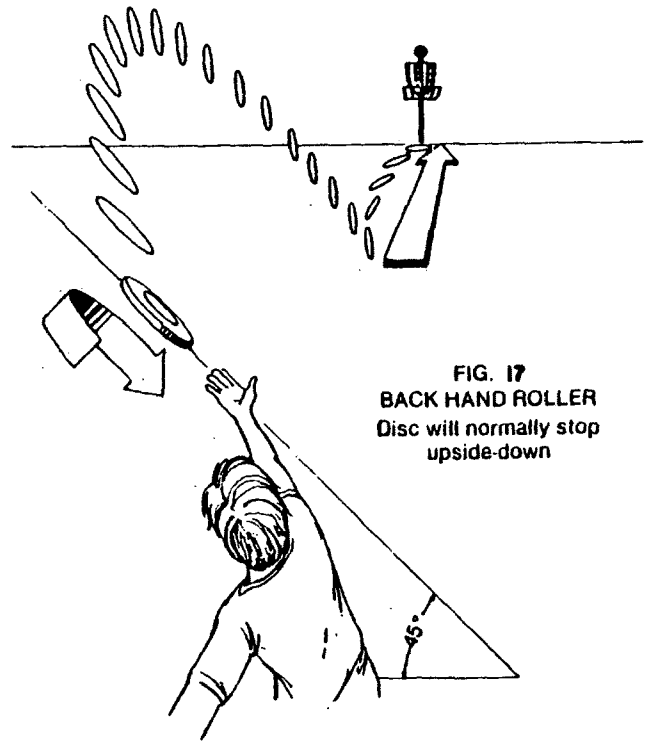


FIG. 17
BACK HAND ROLLER
Disc will normally stop upside-down

higher than any other throw and good distance can be obtained with minimum body motion.

A few players use a roller on approach throws but most prefer a more conventional throw. A low overhanging hazard between you and the hole is what the roller is all about. A well placed roller will go under any hazard that is higher than the diameter of the disc.

The most common short range roller is launched backhand. The angle of launch is about 45 degrees above flat. A short snappy followthrough imparts extra spin. The angle at launch should be high enough to cause the disc to hit the ground almost vertical and then fall over to the right as it slows down (see Figure 17). Wind from the left bothers this roller the most. It will get under the disc and lift it into a right turn if launched at too high an angle. Conversely, if launched with very little angle, the wind will just barely get under the left edge and act like a cushion for it to ride on. A side arm roller spins opposite and responds most to a wind from the right. A thumb roller has the same spin and is probably the most difficult disc throw to master.

CHAPTER 3

TEEING OFF

Covering the start of the game as the last throwing subject in this book may seem upside down. The reason it is last is that you don't need to throw 100 yards to enjoy Disc Golf or to finish in the money, only if you want to win! If you have learned what the previous chapters teach and added some expertise of your own, you should be ready to focus on POWER. The word power needs to be analyzed as it relates to the disc and the tee-off throw.

A disc golfer is not lifting a tremendous weight or pulling a box car. His power is utilized to launch a 170 gram disc at a maximum velocity, bordering on 90 miles per hour, while imparting a violent spin to the disc and controlling its aim and elevation. Some baseball pitchers can break 100 miles per hour with a throw that only has to be accurate a comparatively few feet of flight. Not many ball players can throw a disc 100 yards in the air. The power must be converted to velocity.

The Backhand Throw:

The distance game has become so specialized that it is dominated by backhand throwers, so we will dedicate most of this section to the backhand.

The Backhand Grip:

A look at the history of the grip is enlightening, particularly if you are a player who suffers from that painful middle finger affliction called Frisbee Finger. In the early 1960's, a throw that exceeded 60 yards was unusual. It was obvious that if a disc was to be thrown 70 yards, it would have to be redesigned, at least that was what most players thought. Then, along came Berkeley, a small school in Northern California with a new grip and a throw of 87 yards with the old number 1 mold Professional Frisbee disc, no Frisbee Finger, and the World's Record. A lot of fast study came up with an obvious answer. The old grip had the index finger on, or just under, the rim. The thumb pressure on the flight plate pressed the rim into the side of the middle finger. At time of release, the finger had no place to go but straight out, the disc had no place to go but straight out, so the rim had no choice but to drag the length of the finger. The finger pain wasn't as bad as the pain of losing to a player from Berkeley. The disc went further because it did not lose velocity tearing up the middle finger. Needless to say, the "Berkeley Grip" and its many variations are now the standard for distance. If you still get "the finger", change over. Experiment and find the modification that fits your hand anatomy the best, but remember the main grip is between your thumb and index finger. If you hear a snap between your thumb and index finger when the disc is launched, you are on the right

track.

The most common mistake players make is not using the proper grip, without which power, accuracy, and control of the flight will all suffer. Have a friend hold the disc waist high and horizontal to the ground. Reach out, like shaking hands, with the back of your hand approximately straight up and down. Without turning your hand, close your fingers around the rim. Put your thumb on top of the disc, on the first few ribs (see Figure 18). The rim should rest between the first and second joint of your index finger. Pinch down with your thumb until you feel the pressure on your index finger. The middle finger, ring finger, and little finger may rest on the bottom of the disc or be curled against the inside of the rim. The grip is primarily between the thumb and index finger. The other fingers adjust the angle of the disc in your hand.

The Distance Throw:

To better understand the distance throw, let's start flat footed with the toes touching the line drawn from the hole through the lie. Now without flexing or rotating your torso, see how fast you can move your hand in a backhand motion. Next, do the same motion, only keep your torso rigid from the waist down and move with your arm and shoulders. Your hand speed should almost double. Now relax clear down to your ankles, take a backswing as far back as

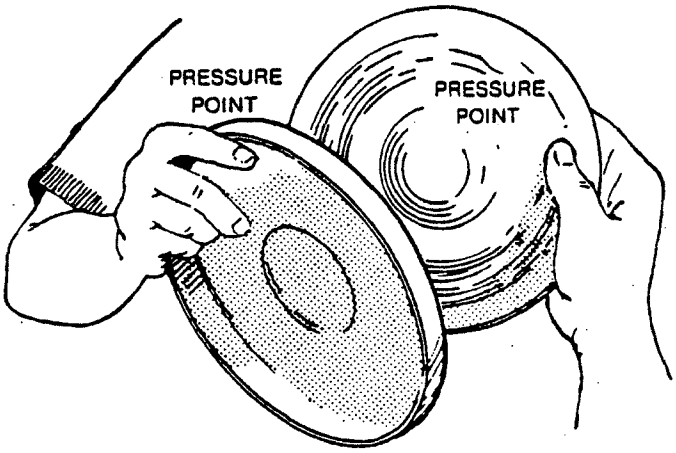


FIGURE 18 — BACK HAND GRIP

you can, like winding up a spring. Now release the spring from your ankles up in sequence. Start to uncoil your ankles, then hips, then shoulders, then arm, and last, the wrist. To insure a flexible movement before you start the backswing, sit down 2 inches. Try the motion again and follow through. An adequate followthrough will pull your left foot off the ground. A good followthrough will pull both feet off the ground. Put a disc in your hand and try each step we have just covered. Practice the last step until it feels like your computer has everything in sequence.

There are many schools of thought as to bending the elbow during the backswing. The fully extended arm is the longest fulcrum we have available to throw with. Why take the chance that it may not be fully extended during the throw? Start with it straight and end with it straight. This will insure maximum hand velocity and you won't have to worry about timing.

Stand with your shoulders and feet in line with the direction of flight. Start the backswing with your wrist cocked and the side of the disc farthest away from you aimed at the spot on the ground about 20 feet away from you. Your right elbow may be rigid or slightly flexed. Complete your backswing at a point as far back as you can stretch, like winding a spring.

Flex your knees, squat down 2 inches, and start your throw (unwind) from your ankles, knees, hips, stomach, shoulders, arm, and last, but most important, your wrist. Then follow through, let your arm continue to swing until it pulls your shoulders around with it. If the disc wants to turn over as it leaves your hand, you may have allowed the edge farthest from you to come up, or your grip between your thumb and index finger needs to be increased. See Figure 19.

Look at the windup from a different angle -- THINK SPRING -- Wind it up slowly, one step at a time from the bottom up. When your shoulders have reached the maximum stretch, start to unwind from the bottom up. Let your ankles pull your knees, your knees pull your hips, your hips pull your shoulders, your shoulder pull your arm, your arm pull your hand, and your hand pull the disc.

Try to keep your wrist cocked through the whole throw. Do not try to snap your wrist, it will snap all by itself and your hand speed can exceed 90 miles per hour. This is not a putt, so don't aim over your disc at the target with your wrist extended (see Figure 20, position 1). Cock your wrist before you do anything else and keep it cocked. To be certain, push the disc over your right forearm with your left hand. This will also insure a slightly negative angle. It may feel uncomfortable for awhile, but stretching your

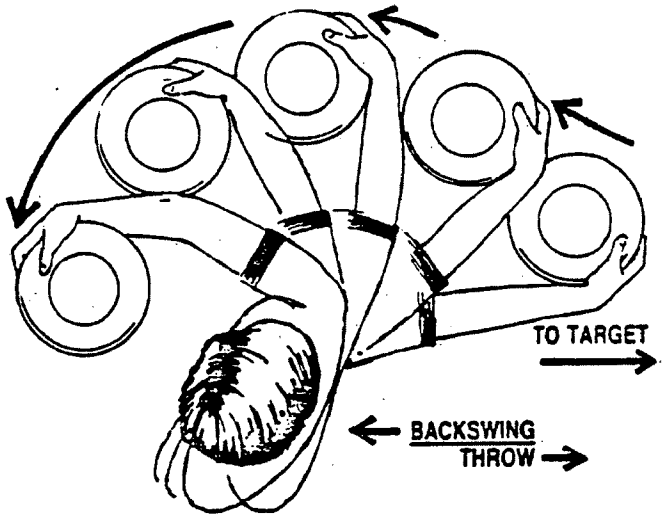


FIGURE 19 — BACK HAND THROW

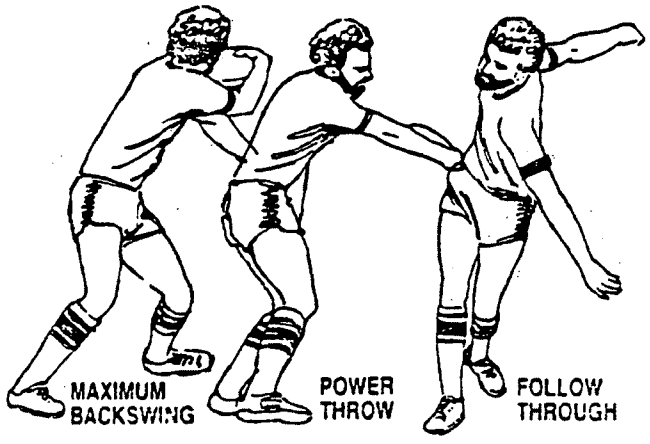
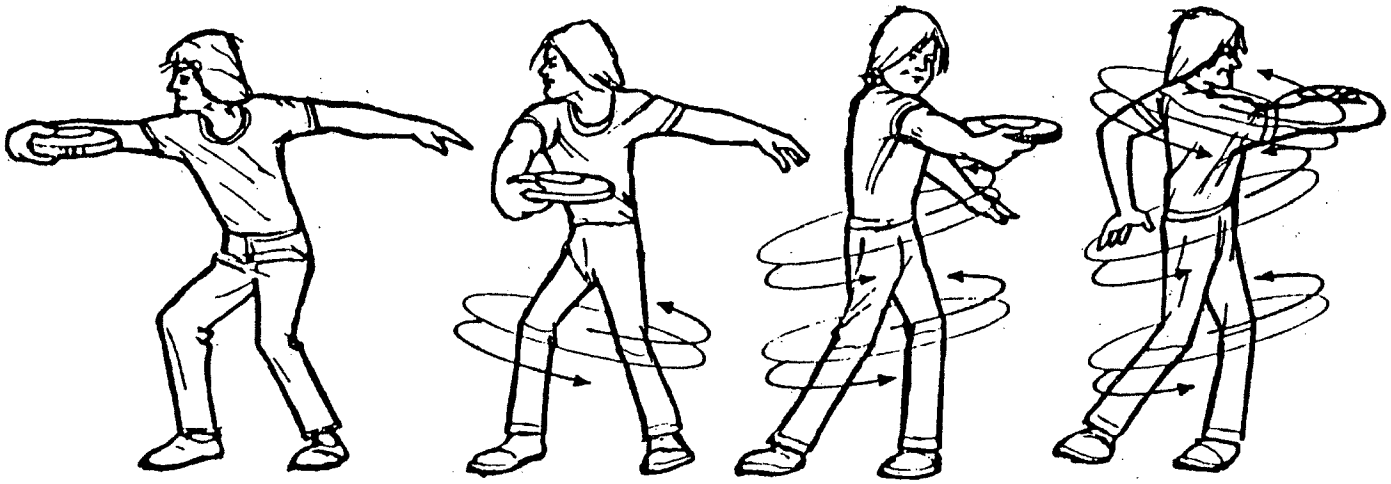


FIGURE 20 — COIL (Backswing)



1. Sit Down 2"
2. Start Backswing With Knees
3. Now Hips
4. Then Shoulders

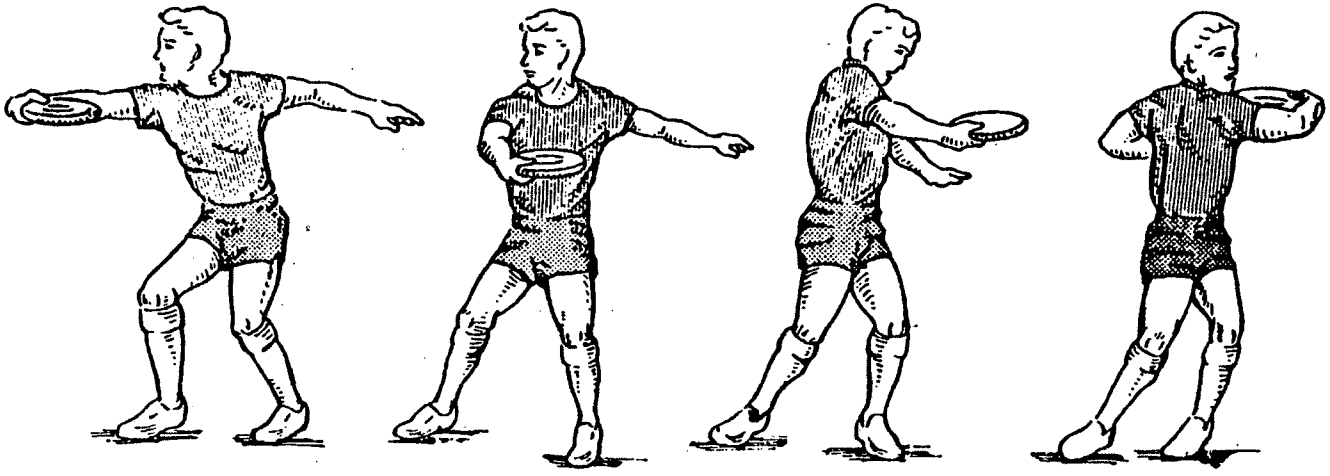
wrist to the maximum greatly increases the velocity of your thumb and index finger which are pulling the leading edge of the disc in excess of 90 miles per hour.

When your arm hits maximum extension and velocity, your wrist will snap open like the cracking of a whip. Your grip between your thumb and finger give the disc its final acceleration and spin. As the disc tears itself free from your grip, the snap of your thumb into your index finger signals the beginning of your followthrough. Relax and enjoy the sensation of unwinding. Let everything flow together smoothly. See Figures 21 and 22 for the entire sequence.

Now let's see if we can wind the spring tighter. Toe the line again and sit down two inches. As you start your backswing, step behind your right foot with your left foot. Reach as far back as you possibly can with your right hand. When you hit the stops, step towards the target with your right foot quickly and firmly. When your right foot plants, your spring will be at maximum tension. Your hips will already be unwinding with the step. Keep them moving and start unwinding your upper torso. Now start unwinding your shoulders. Give your arm everything you've got and hang on to your grip. Think followthrough and finish just like your back swing, but in the opposite position. Don't worry about letting go of the disc. It will launch itself at maximum

Stand up with a disc in your hand and follow each diagram in sequence. Stop in each position and hold it long enough to compare it with the diagram then shift to the next position in slow motion. This will teach your muscles the proper order and will input the correct information into your computer.

FIGURE 21



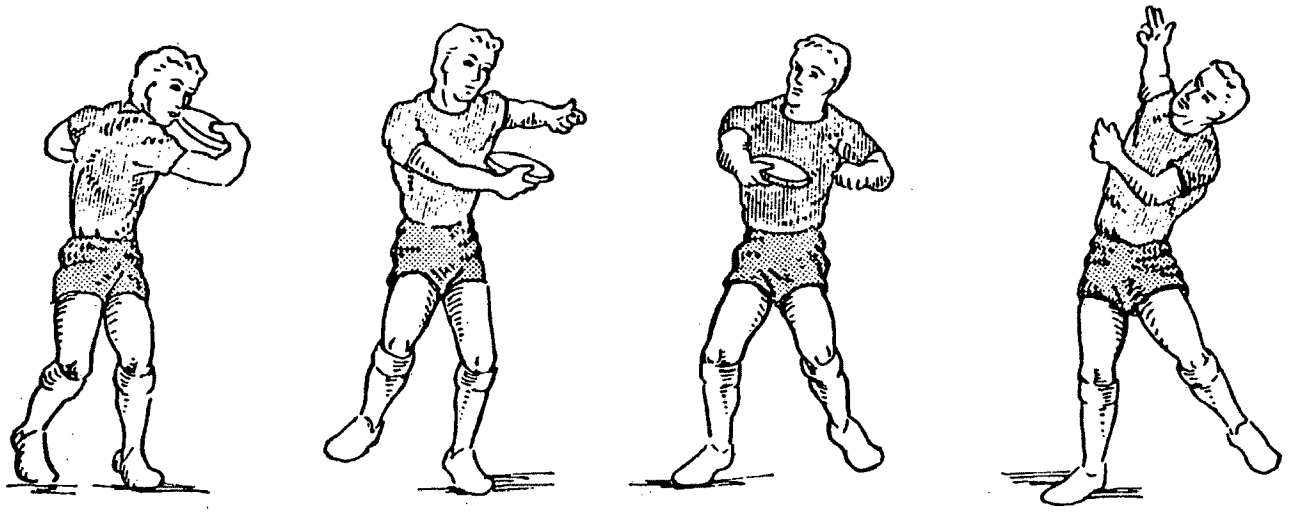
1. SIT DOWN 2"

2. START BACKSWING WITH KNEES

3. NOW HIPS

4. NOW SHOULDERS

FIGURE 22



1. UNCOIL KNEES FIRST

2. NEXT HIPS

3. THEN SHOULDERS

4. ARM & FOLLOW THROUGH

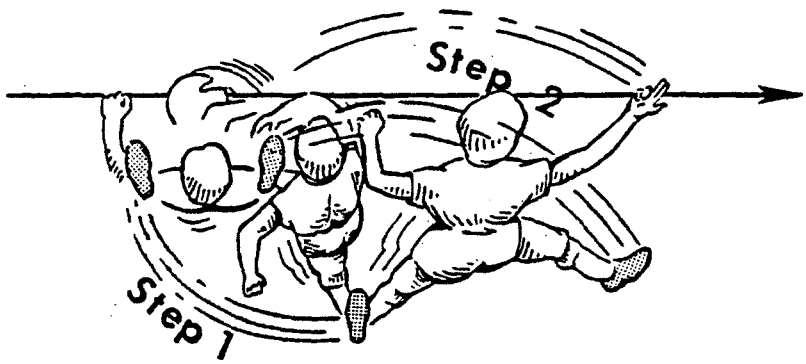
velocity. This throw is called a "two-step" (see Figure 23).

Practice the two-step until your computer has it all sorted out. Remember it has to get thousands of contractions and relaxations in the proper sequence and timing before the whole thing becomes automatic. If you want to add a run-up to the two-step, don't add more than one step a month. Practice it and add it to your computer bank. Don't add more than five steps unless you need the exercise. An excessive run-up will not add any more velocity to your throw.

After you become an accomplished "two-stepper", you can start to learn the turn around. The best place to learn this highly specialized throw is at a national distance contest from one of the few people who are accomplished turn around throwers. It is a rare throw in Disc Golf and not necessary to win the money.

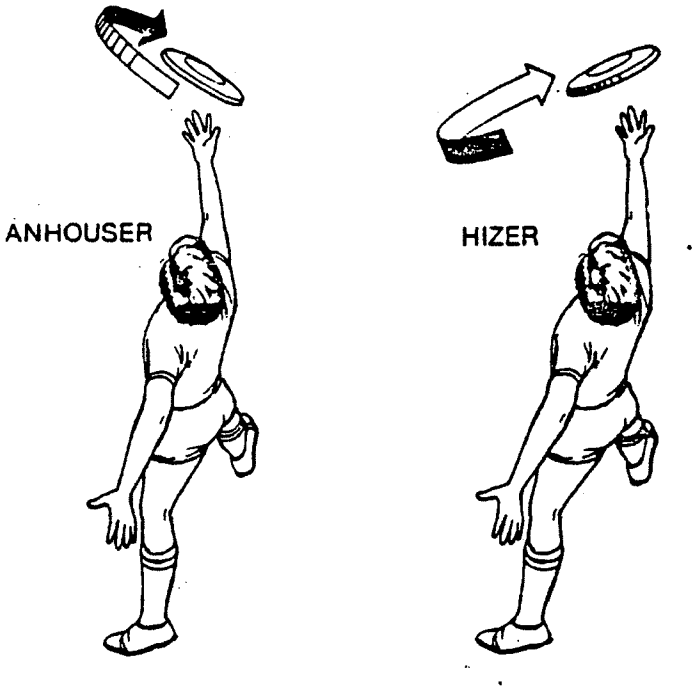
As you know from all the other throws we have discussed and from your own experience, the angle at time of release is extremely critical (see Figure 24). The harder you throw, the more important it is to release at the proper angle. The angle will vary from player to player, but it is always below horizontal. Start at 45 degrees and work your way up. If the disc starts to turn to the right, you have

FIGURE 23



START BACK SWING
Take step No. 1 — Hold maximum back-swing
Take step No. 2 — Start fore-swing when step no. 2 is firmly on ground
Throw with maximum follow-through

FIGURE 24



come up too far.

CHAPTER 4

SPECIALIZED THROWS

The Airbounce:

The Berkeley grip is ideally suited to the need to vary the angle of attack. The normal grip should launch the disc with a slight angle of attack aimed directly at the target. The airbounce grip has an exaggerated positive angle of attack and is aimed at a point beneath the target (see Figure 25). To change the angle keep a tight grip between your thumb and index finger, and without moving your wrist, let your other fingers move up or down, against the bottom of the flight plate. Everything else remains the same. The disc should change angle easily. This will allow you to keep everything else grooved while giving you an infinite range of attack angles.

The Slider:

Negative angle throws are the finesse of the distance thrower. The purpose of this throw is to increase distance. It is accomplished by aiming the throw higher than usual with a negative angle of attack. Figure 26 shows an exaggeration of the flight. The easiest way to master this throw is to set the back edge of the disc on your right forearm when you cock your wrist. The rest of the throw is roughly the same, except the aiming point should be about 5 degrees higher for a long hard throw. This throw is more

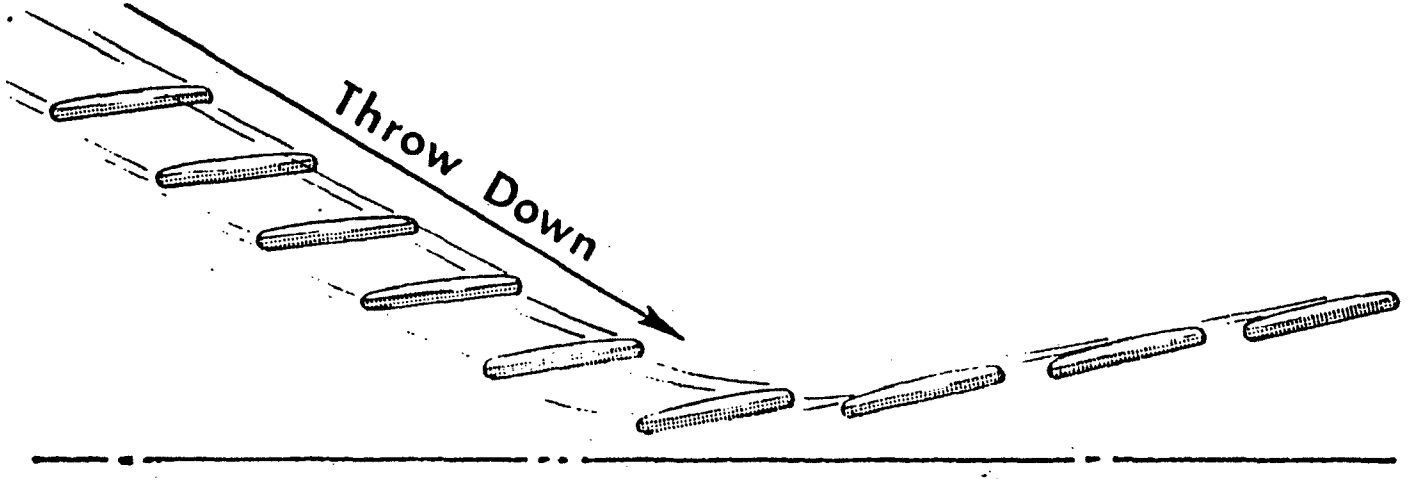


FIGURE 25– THE AIRBOUNCE

This throw is valuable if you need to throw under a low hanging limb or turn a tight corner. It is normally thrown with no Hyser and a positive angle of attack. The flat "bounce" is not difficult to learn but the curve requires a great deal of practice to be reliable.

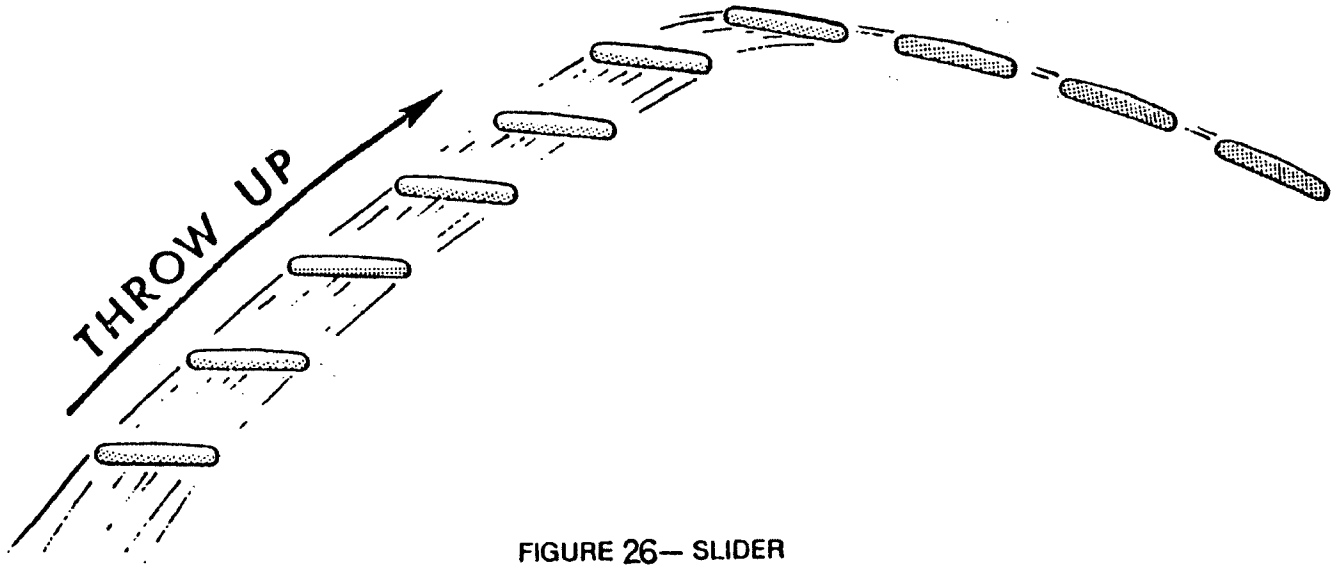


FIGURE 26— SLIDER

difficult to control when used in a soft approach or a putt. The disc is in a stall, has no lift, and very little stability on its upward climb, and is therefore much more susceptible to wind currents and variations of angle. Again, the Berkeley grip is ideal.

Even though several top players have used the slider as a putt, it is very dangerous. A flat putt thrown with the correct amount of velocity and spin will normally fly through the catch zone and beyond. The slider, sometimes called a drop putt, crosses the catch zone at an angle of up to 35 degrees. This means the disc must start its slide at an exact place in the air or it will be either short or long. A good putt is difficult enough without the addition of an unnecessary dimension.

Appendix G

Post-Treatment Instructions

Thanks for coming back in today and for attending each night this past week. What we want to do today is exactly what we did last weekend. Again, just take your time at each throwing line, do as well as you can, and have fun. OK, go ahead.

(On odd numbered trial blocks) -- That's fine. Keep trying to do your best.

(On even numbered trial blocks) -- OK.

(At completion) -- Thanks for your participation. You've really been of great service to us. Here is a little description of what we've done in this experiment (debriefing statement). If you have any questions, please feel free to call. Thanks again.

Appendix H

Debriefing Statement

The purpose of this handout is to inform you of the purpose and procedures of the "Frisbee Throwing" study which you have just completed. This experiment was not only designed to study Frisbee throwing, but it was more importantly designed to study the effects of mental practice on the performance of a disc throwing skill.

Mental practice is defined as the mental rehearsal of a physical skill in the absence of any physical movements. In this study, we asked some of you to mentally practice the disc golf putting stroke in order to determine if it leads to improvement in the skill. Our specific purpose was to show that the group of you who mentally practiced the putting stroke in a predominantly slow motion fashion would show more improvement (i.e. you would make more putts, on the average) than that group of you who mentally practiced the putt in "real-life" speed. Our reasoning for this is that the slow motion subjects would be able to experience more details and would process more information than the standard mental practice group. Furthermore, we hope to show that this second mental practice group improved more than the group of you who received a "Flying Disc Skills

Instructional Package", consisting of films and reading assignments. This group was our experimental control group because it received instruction which was not specifically designed to lead to improvement in putting, even though it may have led those of you in the group to believe that it would be effective. In medical terminology, this was a "placebo" group because it received a treatment which has no active properties with regard to the task we were measuring (i.e. putting). In other words, even though those of you in this group were taught about Frisbee skills, you were not taught about putting skills, and therefore should not show improved putting.

Hopefully, our results will show that each group performed in the predicted ways. If they do not, we may be able to determine why not by analyzing the questionnaires which you have completed over the past week. This is called a manipulation check. and it is designed to tell the researcher whether s/he actually administered each "treatment" in the intended manner. As an example, if our results do not come out as planned (e.g. the placebo group performs at higher levels than either mental practice group), we will want to closely examine the manipulation checks for this group. It might be that a number of subjects in this group had been physically practicing the putting stroke on their own. If these subjects had

completed the questionnaire honestly, we would have been able to see this as being a possible explanation for our results.

At any rate, that is the basic design of our study, and we greatly appreciate your participation in it. If you have any further questions about the study, please feel free to call the number listed below. Also, if you would like to learn more about flying disc sports, I would be more than happy to speak with you about specific skills, local organizations and tournaments, or area disc golf courses. One more thing, since this study is still technically in progress until the end of this weekend, please refrain from discussing it until next week. Again, thanks for your help.

_____

Experimenter

728-6208 (home)

243-6077 (work)